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PUBLIC TRANSPORTATION AND NEIGHBOURHOOD DESIGN:
AN EDMONTON EXAMPLE

by

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A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Public Transportation and Neighbourhood Design: An Edmonton Example" submitted by Ruth Jean Frost in partial fulfilment of the requirements for the degree of Master of Arts.

Supervisor

Date March 8, 1985

This thesis is dedicated to my parents,

Elizabeth Annie (Cogswell) Frost

and

Allin Williams Frost.

ABSTRACT

This thesis attempts to determine, first, if the physical layout of a neighbourhood affects the residents' opportunities to use public transportation and, second, to determine the acceptability to residents of those neighbourhood design features intended to facilitate public transportation services. The concept of activity systems is used as a framework to explore the complex relationship between public transportation planning and suburban residential planning.

Two approaches to activity systems are presented. First, a sociological perspective as advocated by Chapin and his followers proposes that activity systems result from preconditioning and predisposing characterisitics influencing the propensity of individuals to engage in activities, as well as from their perceptions of the supply and quality of opportunities to engage in activities. The thesis concludes that, when this perspective is enlarged to include transportation as a constraint to activity participation, then it is useful for determining the target population of public transportation policies. The second perspective, as proposed by Hagerstrand and his followers, suggests that activity systems are shaped by capability, coupling and societal constraints acting on individuals. The thesis concluded that this approach is better suited to public transportation planning because it provides a framework for distinguishing how and to what degree the attributes of a public transit system will affect its users. Public transportation research is cited to show that spatial, temporal and socio-economic factors affect the decision to use public transportation, and that public transit dependents have reduced access to urban activities. Time expenditure is given as a major constraint to public transit use.

In tracing the evolution of planning concepts concerned with the design of distinct suburban units, it is shown that elements of the activity system concept (that is to say, the provision of facilities for residents' activities and the means of overcoming constraints in using the facilities) have been implicitly addressed. Public transportation has been largely neglected in residential subdivision planning although the American Public Health Association and, more recently, the Canada Mortgage and Housing Corporation proposed design standards for the accommodation of transit service. The standards address transit right-of-way, walking distance and bus stop placement.

The public transit policies of the City of Edmonton, Alberta as applied to the Baturyn neighbourhood in the suburban area of Castle Downs were analyzed in order to determine if the aspirations of transportation planners can be successfully accommodated in the design of residential areas without compromising other desired qualities of residential environments. It is shown that the plans for Castle Downs were changed to reflect the City's emphasis on public transportation as an attractive alternative to the automobile. Community facilities were concentrated at the town centre where bus service could be focused, multiple family housing was located adjacent to future transit routes, walking distances to bus service were minimized and the collector road system was designed to allow efficient bus routing. A questionnaire survey determined that the main travelling constraints facing Baturyn residents were the coupling constraints of time expenditures and the limitations of the bus network. Neighbourhood design had successfully minimized the capability constraint of walking distance. Public transit dependents were shown to have less access to employment opportunities than those respondents with access to an automobile. Preconditioning and predisposing characteristics, in particular sex, age, housing type and car ownership, proved to be more important determinants of modal split than capability contraints. Results of the questionnaire also showed that the inclusion of public transit related features in the neighbourhood was not perceived as detrimental to the quality of the residential environment.

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TABLE OF CONTENTS

CHAPTER PAGE

1. INTRODUCTION 1

2. THE ACTIVITY SYSTEMS CONCEPT AND ITS RELEVANCE TO TRANSPORTATION PLANNING 8

Activity Systems - A Definition 8

The Formation of Activity Systems 11

A Sociological Approach to Activity Systems 11

A Constraints Approach to Activity Systems 14

Activity Systems and Mode of Transportation 19

Activity Systems and Transportation Planning 20

Travel Budgets 23

Public Transportation Planning 26

Socio-Economic Factors of Modal Split 26

Spatial Characteristics of Modal Split 27

Temporal Characteristics of Modal Split 28

The Role of Time Consumption in Modal Split 29

Activity Systems and Public Transportation Planning . . 32

A Sociological Approach to Activity Systems and Public Transportation Planning 33

A Constraints Approach to Activity Systems and Public Transportation Planning 35

CHAPTER PAGE

3. SUBURBAN RESIDENTIAL PLANNING: PRINCIPAL DESIGN CONCEPTS . 37
The Evolution of Some Suburban Planning Concepts 38
The Garden City 38
The Garden Suburb 39
The Superblock 40
The Neighbourhood Unit 41
The Cities in the Suburb 44
Don Mills, Ontario 46
Suburban Residential Planning in Edmonton 47
Use of Neighbourhood Units 47
The Outline Plan Concept and the Hierarchy of Plans 49
The district outline plan 50
The neighbourhood outline plan 51
The subdivision plan 53
The Example of Mill Woods 53
Activity Systems and Residential Design 57
4. SUBURBAN RESIDENTIAL PLANNING: THE CONSIDERATION OF PUBLIC TRANSPORTATION 60
Some Transportation Planning Concepts That Affect the Provision of Public Transportation 62
Road Hierarchies 62
Pedestrian Circulation 65
Public Transportation 66

CHAPTER PAGE

4. Transportation Planning In Edmonton 72

Metropolitan Edmonton Transportation Study (METS) . 72

The General Plan 72

Transportation Plan Part I 74

Public Transportation, Activity Systems and Residential Design 80

5. FORMULATION OF THE PLANS FOR CASTLE DOWNS AND THE BATURYN NEIGHBOURHOOD 83

Castle Downs Outline Plans 83

The Outline Plan Area 83

The Residential Areas 85

The Town Centre 88

The District Campus 89

Transportation 91

Public Transportation 92

The Consideration of Capability Constraints in the Castle Downs Outline Plan 98

Outline Plans For Neighbourhood 6 - Baturyn 100

The Original Submission - December 20, 1972 101

Revision 4 - November 16, 1973 105

Revision 5 - June 10, 1975 108

Accommodation of Public Transit 110

Detailed Subdivision Plans 112

Conclusion 117

CHAPTER PAGE

6. EVALUATION OF THE BATURYN NEIGHBOURHOOD: A HOUSEHOLD SURVEY 120

The Baturyn Neighbourhood in 1981 122

Bus Service in 1981 124

The Questionnaire 129

Purpose and General Description 129

Sampling Method 132

Response Problems 134

Profiles of Households and Individuals 136

The Extent of Public Transit Use 140

Employment and School Trips 140

Shopping Trips 150

Other Trips 156

Discussion 156

Perceived Quality and Availability of Public Transit Facilities and Services 159

Design of Residential Areas 162

Transit Operations 164

Land Use 169

Public Transit Facilities 175

Conclusion 181

CHAPTER PAGE

7. CONCLUSION 184
    Assessment of the Thesis Procedures and Results 186
        Constraints Affecting Public Transit Users in Baturyn 186
        Constraints Affecting the Provision of Public Transportation 190
        Acceptabilty of Public Transit-Related Facilities . 191
        Applicability of the Activity Concept to Public Transportation Research 194
    Implications for City Planning 196
    Suggestions for Further Research 197

REFERENCES 199

APPENDIX THE QUESTIONNAIRE SURVEY 206

LIST OF TABLES

Table	Description	Page
1	Detailed Subdivision Plans for the Baturyn Neighbourhood	114
2	Questionnaire Sample	135
3	Household Profile	137
4	Profile of Individual Household Members	138
5	The Effect of Walking Distance on Public Transit Patronage for Employment and School Trips	142
6	Modal Choice by Strata and Class for Employment and School Trips	142
7	Modal Choice by Destination for Employment and School Trips	144
8	The Effect of Sex on Modal Choice for Employment and School Trips	147
9	The Effect of Age on Modal Choice for Employment and School Trips	148
10	Age of Respondents Using Mode	148
11	The Effect of Occupation on Modal Split for Employment and School Trips	149
12	The Effect of Household Car Ownership on Modal Split for Employment and School Trips	151
13	Frequency of Shopping Trips	152
14	Modal Split for Shopping Trips	153

Table	Description	Page
15	The Effect of Walking Distance on the Use of Public Transit for Shopping Trips	155
16	The Sex of Respondents Using Public Transit For Shopping Trips	155
17	The Effect of Walking Distance and Sex on Modal Choice for Varying Trip Purposes	157
18	Ranking of Reasons for Not Using Public Transit by Trip Purpose	161
19	Transit Operation and Neighbourhood Design	165
20	Rear Lanes	167
21	Housing Location	170
22	Location and Provision of Schools and Parks	172
23	Commercial Facilities	174
24	Location of Bus Stops and Bus Service	177
25	Provision of Public Transit Facilities	179
26	Bus Stop Usually Used and the Route Usually Taken to the Stop	180

LIST OF FIGURES

FIGURE PAGE

1. Location of Castle Downs in Edmonton, Alberta 5
2. Chapin's General Model for Explaining Activity Patterns 12
3. A Space-Time Prism of an Employed Person 17
4. Comparing An Idealized Space-Time Prism With a Restricted Space-Time Prism 18
5. An Adaptation of Chapin's General Model for Explaining Activity Patterns 34
6. The Neighbourhood Unit Concept 43
7. The Hierarchical Organization of Mill Woods, Edmonton 55
8. CMHC Recommended Road Hierarchy 64
9. Local Streets Planned to Provide Direct Pedestrian Access 71
10. Sidewalks and Walkways 78
11. North Edmonton Outline Plan 84
12. Amended Castle Downs Outline Plan 87
13. Proposed Bus Routes 96
14. Castle Downs Recommended Transit Plan 97
15. Baturyn Neighbourhood Outline Plan, December 20, 1975 102
16. Baturyn Neighbourhood Approved Plan - Revision 2, August 14, 1975 106
17. Baturyn Neighbourhood Outline, Plan - Revision 5, June 10, 1975 109
18. Approved Baturyn Neighbourhood Outline Plan 111
19. Detailed Subdivision Plans for Baturyn Neighbourhood 113

FIGURE PAGE

20. Location of Bus Stops 116
21. The Baturyn Neighbourhood in 1981 123
22. Bus Service in Baturyn - October 1981 126
23. Sampling Strata 133
24. Destination Zones for Employment and School Trips 145

CHAPTER 1

INTRODUCTION

For three and one-half years, I was employed as a planner by Edmonton Transit. One of my most interesting and challenging responsibilities was the critical review of the provision of public transportation facilities in plans of new residential subdivisions to determine if the street layout, the distribution of residential densities, and the placement of commercial, educational and recreational land uses would permit Edmonton Transit to meet service guidelines set by city council and would encourage the use of public transportation. In performing this task I became aware that there was insufficient understanding of how the physical design of neighbourhoods affected both the use and the operation of a public transportation system. I also found I was developing a myopic view of residential design by concentrating on public transportation problems. I therefore began to question the importance of efficient public transportation within residential areas, and to ask whether other aspects of physical design should take precedence over features required by public transportation systems. I also wondered how future residents would evaluate the transportation-related features in their neighbourhood. Did the incorporation of these features actually encourage the use of public transportation and were unanticipated costs associated with the features?

With these questions in mind, the thesis was designed to try to determine, first, how the physical layout of a neighbourhood affects the opportunities for residents to use public transportation when travelling to their daily activities, and, second, the acceptability to residents of those neighbourhood design features intended to facilitate public transportation services. The possibility of conflicting planning goals is implicit in these research objectives and establishes the link between them. That is, if the aspirations of public transportation planners are successfully accommodated in the design of new residential areas is there a risk that other desired qualities of residential environment will be jeopardized or compromised? This general question will be addressed in the thesis through an analysis of the public transportation planning policies of the city of Edmonton, Alberta as applied to the suburban area of Castle Downs and, more specifically, the neighbourhood of Baturyn.

Three large fields of research are pertinent to the thesis: activity systems; urban transportation planning, in particular public transportation planning; and land use planning, specifically suburban development. It is proposed that the concept of activity systems provides the necessary framework for exploring the complex relationship between public transportation planning and suburban residential planning.

The raison d'être for daily urban travel is made explicit by the discussion of activity systems: if individuals, households and institutions are to pursue their daily affairs and interact with each other, travel is not only mandatory but is a constraint affecting the activities that can be undertaken. Because business, commercial, educational and recreational land uses are located in different areas of a city, the potential for individual people to participate in these activities is partially determined by their ability to travel. Urban travel requires expenditures of time, energy and usually money. Mitchell and Rapkin (1954, p.179) realized the constraining nature of travel when they stated that the objective of transportation planning is the "adjustment of movement channels (consistent with available resources) to facilitate the activities of an urban area as much as possible; and, at the same time, to reduce as much as possible the limitations which the channels may impose on growth or change in the city's activities."

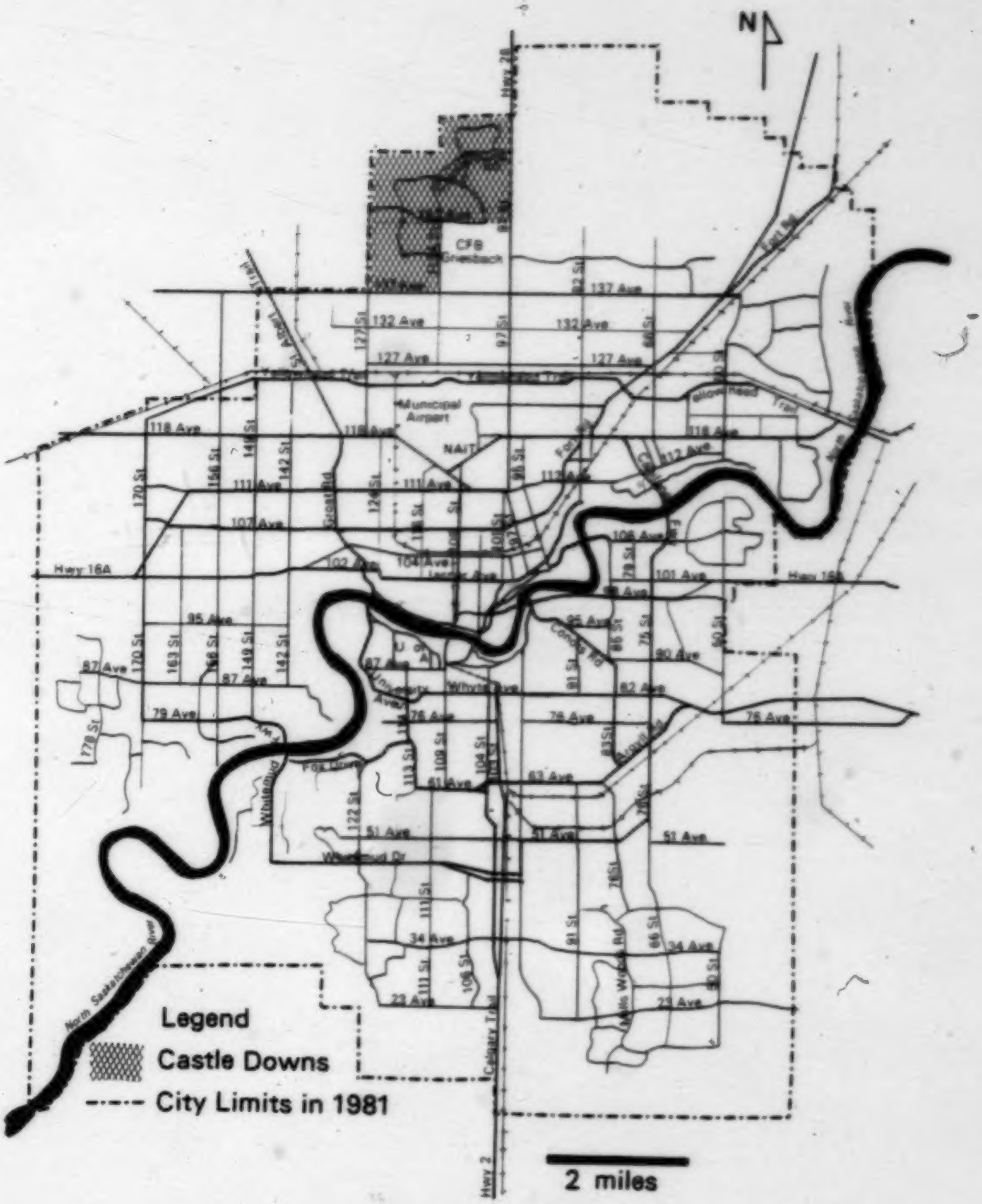
In Chapter 2, the concept of activity systems is defined and the two main approaches to the concept are explored. Chapin and his followers have suggested that a sociological perspective should be taken, whereas Hagerstrand and his Swedish colleagues have proposed that activity systems are a result of constraints facing the individual. Similarly, past public transportation research has attempted to explain transit use in sociological terms, whereas researchers are now suggesting that the constraints facing the potential user should be recognized. Both approaches to activity systems are applied to public transportation use in this thesis, but greater emphasis is placed on the constraints point of view.

While urban transportation planners have attempted to reduce the effects of the constraints imposed by travel, land-use planners have attempted to determine the mix and number of facilities that should be available within the suburban residential community and the extent to which residents should be expected to travel to fulfill their various needs. Theoretical developments in suburban residential planning from Howard's Garden City proposal to Carver's notion of Cities in the Suburbs are traced in Chapter 3. Residential planning practices in Edmonton are reviewed as well, and the current policy of directing urban development into so-called outline plan areas is discussed. It is shown that the concept of activity systems has been implicitly applied throughout the modern history of residential planning.

A common theme in residential planning is the need for safe, convenient access to the daily activities and facilities used by residents. Indeed, the constraints imposed by the available transportation systems affect the activity systems of the residents. Chapter 4 describes some concepts for accommodating traffic and pedestrian circulation in residential design. Attention is focused on public transportation facilities and some guidelines for the required level of transit service are cited. Ways to minimize constraints facing public transit patrons and proposals to allow efficient transit services are discussed. Finally, the public transportation policies of the city of Edmonton are given.

Unlike many North American cities, it has been civic policy in Edmonton to promote public transportation as a viable and attractive alternative to the private automobile. Consideration of public transportation facilities has therefore been included at all stages in the planning of new suburban areas. The thesis attempts to determine the success of these policies by studying the case of the Baturyn neighbourhood in the community of Castle Downs on Edmonton's northern outskirts (Figure 1). In Chapter 5, the planning of Castle Downs

FIGURE 1
THE LOCATION OF CASTLE
DOWNS IN EDMONTON, ALBERTA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CFB Griesbach
137 Ave
132 Ave
127 Ave
Municipal Airport
NAIT
118 Ave
111 Ave
107 Ave
Hwy 16A
102 Ave
104 Ave
101 Ave
95 Ave
87 Ave
82 Ave
79 Ave
76 Ave
63 Ave
61 Ave
51 Ave
34 Ave
23 Ave
170 St
156 St
149 St
142 St
127 St
97 St
82 St
66 St
50 St
Yellowhead Trail
Fort Rd
Whyte Ave
University Ave
U of A
Connors Rd
Sherwood Park Fwy
Whitemud Dr
Fox Dr
Calgary Trail
Mill Woods Rd
North Saskatchewan River
Hwy 2
Legend
▨ Castle Downs
-·-·- City Limits in 1981
2 miles

outline plan area and the neighbourhood of Baturyn is traced. The extent of consideration given to public transit requirements is described.

In Chapter 6, the results of a resident survey are analyzed. The survey was undertaken to determine the main travelling constraints facing the residents and whether the planning policies had, in fact, minimized those travel constraints that could be attributed to the physical design of the neighbourhood. As well, the survey tried to establish if residents perceived that the quality of their neighbourhood was affected by features that promoted and facilitated the use of public transit. In this way an attempt was made to determine if the accommodation of public transportation facilities is compatible with neighbourhood design theory.

The Baturyn neighbourhood was chosen as a study area for four reasons. First, Baturyn can be easily recognized as a unit; it is bounded by arterial roads and the previous city limits. Second, at the time the thesis was undertaken, the neighbourhood was largely developed and so a comprehensive analysis from design to implementation was possible. Third, the bus service was essentially a single route, allowing a simple analysis of transportation use. Finally, through my work at Edmonton Transit I was familiar with the area.

In the past, public transportation has not been adequately considered in residential design theory. However, to insure efficient transit operations, it is imperative that transit requirements be considered from the earliest stages of the planning of suburban areas. In this thesis it is argued that when the concept of activity systems is explicitly applied to suburban planning, the necessity of including public transportation facilities as part of that planning is self-evident. At the same time, it has to be realised that there may be unanticipated costs associated with the incorporation of public transit-related features in residential areas. In recognizing travel limitations and in anticipating costs in the planning stages, the necessary measures can be adopted to minimize those costs and limitations. It is hoped that the suggestions made in this thesis will help planners design suburban areas in which public transit services can be offered efficiently and attractively, without deleterious effects on other valued qualities of the residential environment.

CHAPTER 2

THE ACTIVITY SYSTEMS CONCEPT AND ITS RELEVANCE TO TRANSPORTATION PLANNING

ACTIVITY SYSTEMS - A DEFINITION

Chapin defined urban activity systems as "the patterned ways in which individuals, households, institutions and firms pursue their day in and day out affairs in a metropolitan community and interact with one another in time and space" (Chapin, 1974, p.23). Behaviour is shaped by individual and societal values, and tends to form recognizable patterns which are repeated daily or weekly and which change with the seasons and with progression through the life cycle. Chapin (1978) identified households, individuals, firms and institutions as 'activity agents' who engage in activities in order to fulfill their living and functioning needs. When viewed in total these activities form activity systems which are also spatial systems because the activities are undertaken at different locations. Households and individuals have activity systems for producing income, for relaxation and recreation, for education and for shopping; firms have activity systems for producing goods and for providing services for their clientele; institutions have welfare and service activity systems. Some of these systems have sufficient duplicating and spatial characteristics to shape the physical structure of the city. Spaces are adapted for place-related activities and channels are formed to accommodate movement between activities and to permit communication between agents.

Individuals are motivated to participate in activities in order to satisfy various needs. Some needs are physiological in nature: for example, people must eat, sleep and have shelter and clothing. Other needs have cultural or social roots: for example, people feel the need for social interaction, status and achievement. Activities may be obligatory - that is to say, the person has no choice whether or not to participate - or they may be discretionary, though there is no sharp distinction between them. Rather, there is a continuum, as the freedom to participate diminishes or increases (Chapin, 1974). Most obligatory activities satisfy physiological needs while discretionary activities satisfy social and cultural needs. In addition, as individuals age and progress through the life cycle, their needs (and hence their activities) change.

The activities that comprise the systems have properties of "duration, a position in time, usually designated by the start time, a place in a sequence of events, and a fixed location or a path in space" (Chapin, 1974, p.37). In the past, geographers have tended to ignore time and have concentrated on activities and spaces. Yet, all activities take place in time as well as space, and time is a useful common denominator for describing activities. The point in time at which activities occur can be fixed; the frequency and sequencing of activities can be determined; the duration of activities can be measured. It is this last trait that has received the greatest amount of attention, perhaps for the reason that every person has 24 hours in which to engage in the daily round of activities.

Becker (1965), an economist, developed a utility theory of the value of time, in which time is likened to money. It is a resource which can be used or 'spent' to obtain goods or satisfaction. The value of time varies amongst age groups, and amongst economic and social segments of society, according to the use to which it is put, and according to the time period. Because high-income groups have a greater opportunity for economic gain through the expenditure of time, they place a higher monetary value on time than do lower income groups. High-income groups are more likely to 'buy' time through purchases of time-saving devices, whereas lower income groups are more likely to substitute time for money. Time also has a lower monetary value on weekends than on working days, because the opportunity to trade time for economic gain is less.

The study of time allocation - the duration, sequencing, frequency and timing of activities - can lead to a better understanding of activity systems, though its limitations must also be recognized. First, time allocation explains neither the purpose nor the nature of activities. Second, the importance of 'clock' time can be overemphasized. Seasonal time and stage in the life cycle also affect activity systems in critical ways. Third, culture affects the perception, and hence the importance, of time.

THE FORMATION OF ACTIVITY SYSTEMS

Two approaches have been adopted in the study of activity systems. Chapin and his followers have taken a sociological orientation in suggesting that activity patterns result from individuals being motivated to meet socio-cultural needs. Social role determines the activities in which each person participates. The second approach, developed by Hagerstrand and some other Swedish geographers, focuses on the constraints that the physical environment - both natural and man-made - places on individual activities.

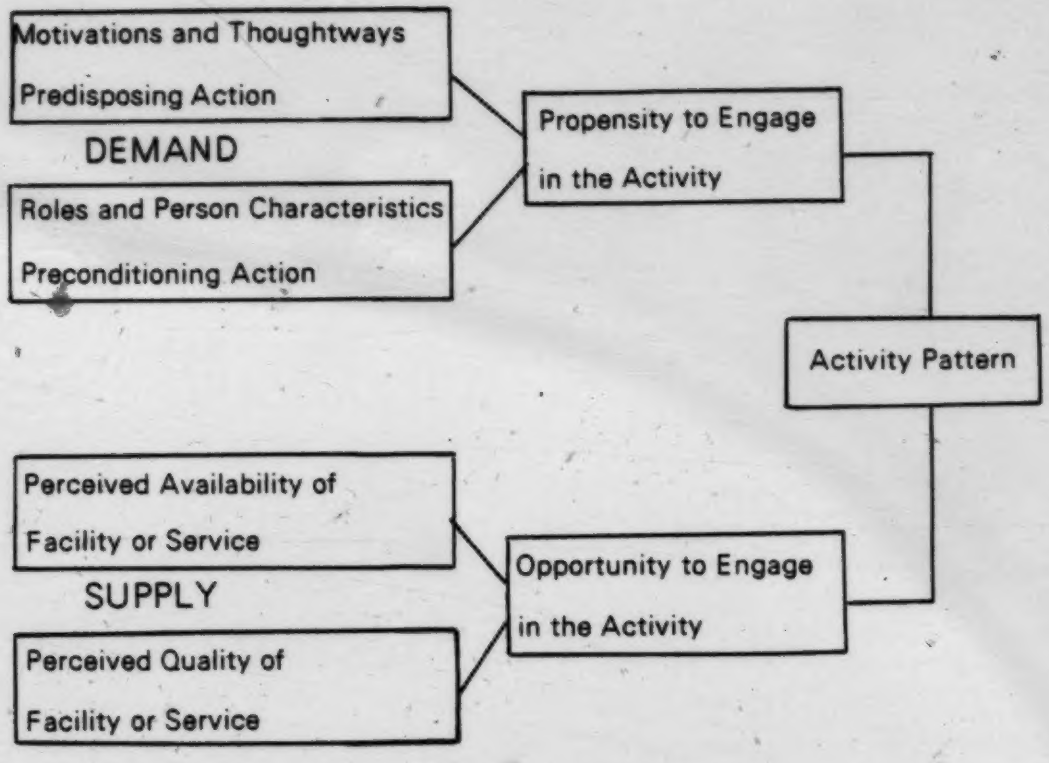
A Sociological Approach To Activity Systems

The model developed by Chapin to explain the formation of activity systems is presented in Figure 2. The top half of the model shows the potential demand to participate in activity patterns. The inclination or predisposition to participate is a function of the person's status, security and achievement needs. However, people are constrained or preconditioned by their sex, stage in the life cycle, health, work status and income, and these factors determine the choice of action. Preconditioning factors are essentially personal characteristics which can be identified from objective surveys or existing statistics. Predisposing factors are more difficult to discern because they are based on subjective preferences and attitudes.

The bottom half of the model defines the limitations set by the environment and so can be viewed as the supply of opportunities.

FIGURE 2

CHAPIN'S GENERAL MODEL FOR EXPLAINING ACTIVITY PATTERNS


Motivations and Thoughtways Predisposing Action
DEMAND
Roles and Person Characteristics Preconditioning Action
Propensity to Engage in the Activity
Activity Pattern
Perceived Availability of Facility or Service
SUPPLY
Perceived Quality of Facility or Service
Opportunity to Engage in the Activity

Source: Modified from Chapin (1974) p.33

Chapin emphasized that the individual's perception of the availability and quality of the service or facilities is the important factor, not the actual availability and quality.

Feedback mechanisms influence both halves of the model. The satisfaction or dissatisfaction experienced from participation in activities modifies the individual's thoughtways and motivations. The public and private sectors will respond to the rate of use of existing facilities and services, and to public demand for new or improved facilities, by increasing investment in existing facilities, diverting investments from one facility to another, or increasing the accessibility of services and facilities (Chapin, 1974).

Chapin isolated location behaviour as a special type of action which results in the adaptation of spaces for place-related activities and in the creation of movement channels to facilitate travel and communication between activity places. Location behaviour is of particular interest to land use and transportation planners because it is this behaviour that structures the physical form of the city. If planners can influence the decision process in location actions it should be possible to direct the physical consequences of the actions towards the desired outcomes. Location decisions are either 'priming decisions' - discrete actions of strategic importance - or 'secondary decisions' - actions triggered by the priming decisions. By making priming decisions, planning authorities attempt to direct secondary decisions towards the desired goals. Chapin argued that to achieve the desired spatial outcomes a knowledge of attitudes of population groups, as well as of their activity patterns, is necessary.

At first, Chapin concentrated on the propensity to engage in activities in the demand or upper half of his model, and conducted a number of studies on the pursuit of discretionary activities during recreational or leisure time (see Chapin and Hightower, 1965; Brail and Chapin, 1973). Later, however, he refined his model to give more recognition to the constraints that limit or postpone an individual's choice of activities, though his own research remains focused on the demand portion of the model (see Chapin, 1978).

A Constraints Approach to Activity Systems

Hagerstrand and other Swedish geographers have concentrated on the factors that limit the ability to engage in activities. Although this approach touches on the 'roles and person characteristics' portion of Chapin's model, it is more concerned with the opportunities to engage in activities. Hagerstrand suggested a person is severely restricted by constraints arising from physical and physiological needs, private and common desires, and societal demands. Depending on their nature, the constraints fall into three groups (Hagerstrand, 1970).

First, capability constraints result from a combination of biological limitations and the technological limits of tools and machines. These constraints may be time oriented; for example, a person needs to eat and sleep at regular intervals. They may also be distance oriented; for example, the distance a person can travel within a specified time is limited by the mode of transportation employed. Someone who is walking can probably travel no further than four to five kilometers per hour. Using a car, it is possible to travel 90 to 100 kilometers per hour under good driving conditions.

Second, coupling constraints arise with the individual's need to have access to other people and resources in order to partake in various activities. Coupling constraints require that participants or machines be in the same location at a specified time and for a specified length of time. Clock and calendar time are the greatest dictators of coupling constraints.

Third, society sets constraints restricting the time or space domains to which an individual has access. The various laws, social institutions and power structures regulate who may gain access to facilities and resources and when this access may be gained. For example, there is a minimum age for holding a driving licence and employers regulate the hours their employees must work.

Hagerstrand (1975) later refined and expanded his list of major constraints by adding the following:

1. A person (and many other objects) cannot be divided into smaller, functioning entities.
2. A person can usually partake in only one task at a time.
3. There is a physical limit to the number of people or objects that will fit into a space at one time.
4. Each task consumes time.
5. It takes time to travel between points in space.
6. Each human life is limited in length.
7. Every action and situation is affected by past actions and situations.

The first three constraints may be termed capability constraints. The remaining four reflect the greater importance Hagerstrand gave to time. His analysis of time was not restricted to clock time but also included biological time - the entire life of an individual.

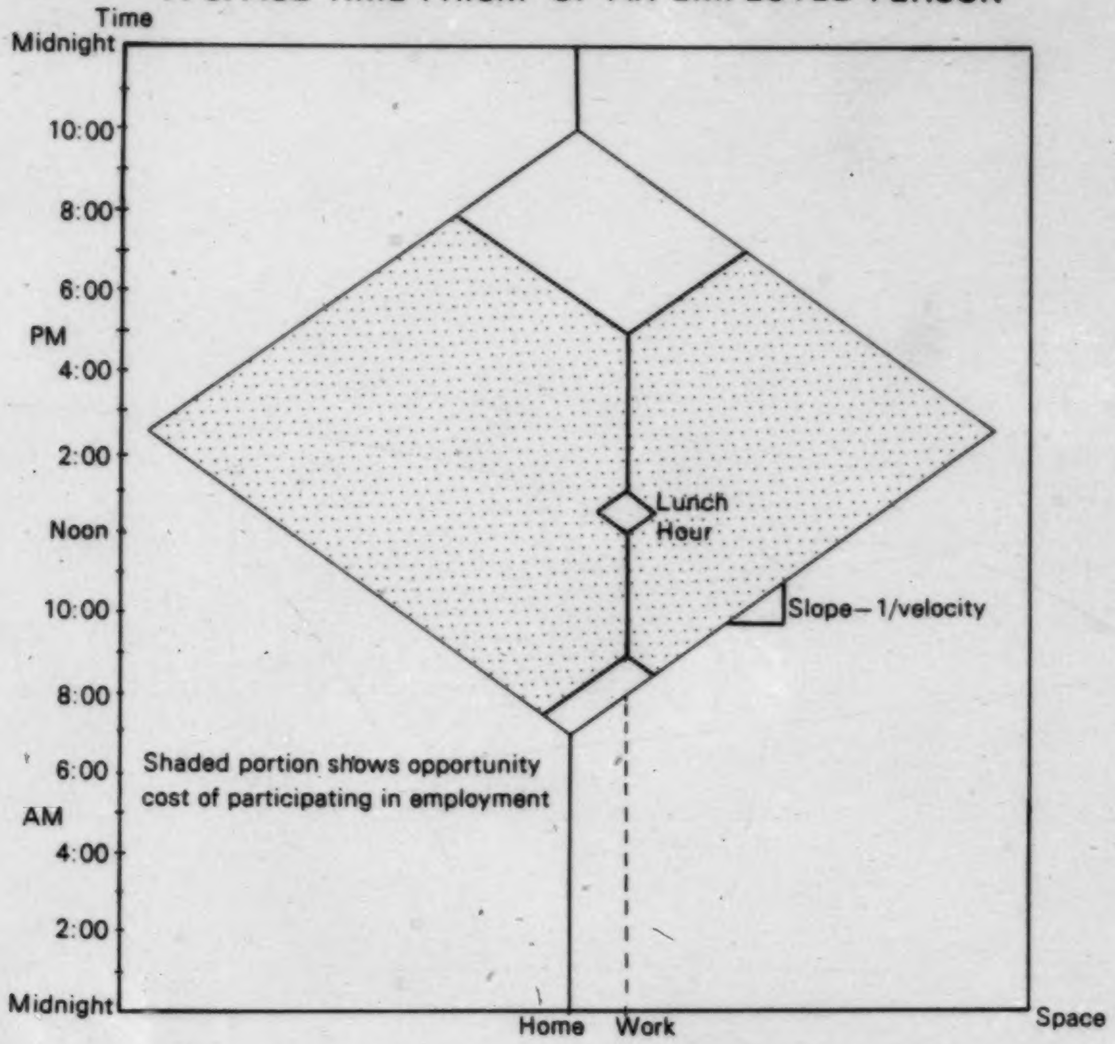
The space-time prism is a useful way to illustrate how transportation mode affects the opportunity to engage in activities. An example of a space-time prism is shown in Figure 3. Here, space is further collapsed to one dimension and time is the second dimension. The individual is constrained by set hours of employment in an office. While he remains in one location his path in space time is parallel to the vertical or time axis. When he travels his path moves along both the space and the time axes. To reach his office, for example, he must travel in the direction of the office, but during his lunch hour he is able to travel in any direction as long as he can return to the office in time to recommence work.

In an ideal situation each person could travel in all directions (Figure 4.a). The individual space-time prism would then have a conical shape, the volume of which is determined by the person's velocity and the time spent travelling. All activities located within the cone will be accessible, assuming the individual meets the necessary entrance criteria. Within an urban setting, travel by car and foot most nearly approximates the ideal situation. Roads exist in most directions. The cone will be much larger for the car occupant than the pedestrian unless, of course, congestion has halted traffic flow.

The idealized space-time prism is distorted when restrictions are

FIGURE 3

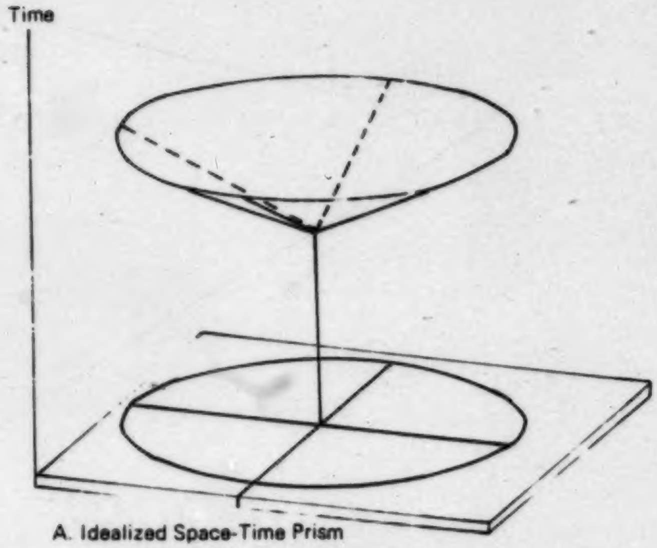
A SPACE-TIME PRISM OF AN EMPLOYED PERSON


Time
Midnight
10:00
8:00
6:00
PM
4:00
2:00
Noon
10:00
8:00
6:00
AM
4:00
2:00
Midnight
Lunch Hour
Slope—1/velocity
Shaded portion shows opportunity cost of participating in employment
Home
Work
Space

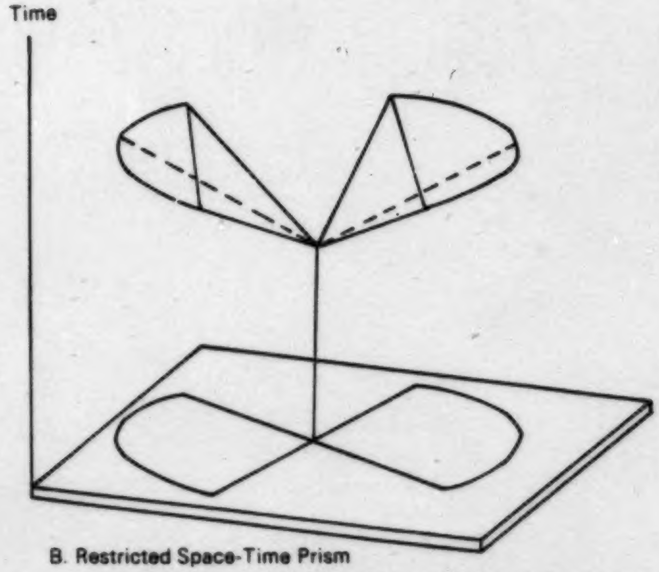
Source: Modified from Burns (1979) p.16

FIGURE 4

COMPARING AN IDEALIZED SPACE-TIME PRISM WITH A RESTRICTED SPACE-TIME PRISM



A. Idealized Space-Time Prism
Travel is possible in all directions



B. Restricted Space-Time Prism
Direction of travel is restricted by available transit routes

The prisms have the x-axis rotated 20% and the y-axis tilted 20% towards the observer.

Source: Modified from Lenntorp (1976) p.22

placed on the individual's travel (Figure 4.b). A public transit user faces several restrictions that the car user does not. There is, for example, a coupling constraint arising from the need to board a vehicle at a loading point. This usually requires a walk followed by a waiting period. Then, travel is possible only in the direction(s) offered by the transit routes that serve the chosen stop. In many residential areas there is only one route which offers travel in one or perhaps two directions. These constraints severely diminish the size of the possible space-time prism. The walking and waiting portions of the trip reduce overall velocity and hence the volume of the prism is smaller. The restrictions of direction reduce the prism to only one or two segments (or however many directions are offered) of the idealized prism.

Activity Systems and Mode of Transportation

A number of geographical studies have focused on the effects of the mode of transportation on activity systems. Hemmens (1966) illustrated how the mode influences the size of activity spaces. Using home surveys he gathered information on the purpose of trips originating from the home. He concluded that the occurrence of trips that have more than one destination and one purpose varies directly with high car ownership, high income and high economic status.

Lenntorp (1976) developed a computerized simulation model which he applied to the shopping behaviour of residents of Vallingby, Sweden. He concluded that multi-destination trips were difficult for public transit users. A later study applied the model to employment and daycare opportunities in Karlstad, Sweden. Here, Lenntorp (1978) found that under the given time constraints many opportunities were not available to the person dependent on public transportation, but all the opportunities were available to the motorist. A similar conclusion was reached by Martensson (1978) in an analysis of employment, recreation and service opportunities in three Swedish regions, and again by Ellegard, Hagerstrand and Lenntorp (1977) in an application of the activity system concept to future transportation demands.

The above studies have isolated two major constraints facing public transportation users. First, the user can partake only in activities that are serviced by public transportation modes. Second, more time is expended reaching activities when public transportation is used. The studies illustrate that space and time are both important determinants of activity systems.

ACTIVITY SYSTEMS AND TRANSPORTATION PLANNING

Because activities are separated in space, travel is a necessary and time-consuming component of individual activity patterns. On the one hand, an understanding of the opportunities offered and constraints imposed by transportation systems should improve the study of activity systems. On the other hand, an understanding of activity systems should help planners to develop a transportation system that serves the real needs of the people.

In the past transportation planning has been preoccupied with the provision of roads and the preparation of long-range, concrete plans for the improvement of traffic flow. This preoccupation is now being replaced by a concern to develop a transportation system which both complements adjacent land uses and allows the urban population maximum accessibility to housing, employment, shopping and recreational opportunities. Hensher (1979) argued that the paradigm of a plural society with conflicting goals and objectives has replaced the paradigm of a consensus-seeking society, and this caused the planning process and scope of planning to change.

Planners currently place less emphasis on producing master plans and have greater interest in the planning method. Goals and objectives are developed separately from the analytical and descriptive processes, and evaluation of the goals and objectives is a continuous process. Long-range strategic planning is also separated from detailed planning, but interaction between the two areas is emphasized. In trying to achieve a more comprehensive approach transportation planners are interacting more with planners in other fields. Hensher (1979, p.10) advocated the study of activity systems as a means for transportation planners to achieve a comprehensive plan and to incorporate the diverse and conflicting nature of society. Through activity planning, he argued, the "artificial distinction between land use and transport plans would be redundant."

This vein of argument is not new. As early as 1954, Mitchell and Rapkin advocated the inclusion of activity system investigation in transportation planning. It was their thesis that the amount of movement of goods and people was a result of the amount and nature of urban activities. These activities are caused, first, by the requirement to satisfy certain needs, some of which are basic and unchanging, while others vary in time; second, by the organizational structure of interacting groups and individuals; and, third, by the institutional structures of modern society. According to Mitchell and Rapkin (1954), the spatial and functional organization of establishments, as well as their size and nature, affect the volume of urban traffic generated. In turn, the ease of travel and communication contributes to the volume and nature of urban activities.

Given that the transportation system can limit the nature and intensity of activities and interactions, Mitchell and Rapkin (1954, p.179) stated that transportation planning should be "the adjustment of movement channels (consistent with available resources) to facilitate the activities of an urban area as much as possible; and, at the same time, to reduce as much as possible the limitations which the channels may impose on growth or change in the city's activities." The Swedish geographers followed the same theme in their research into the ways in which individual activity patterns are constrained by the existing transportation system. Hagerstrand's capability, coupling and authoritative constraints are remarkably similar to Mitchell and Rapkin's list of factors affecting the amount and nature of urban activities. Transportation planning research did not immediately follow Mitchell and Rapkin's lead, although land use models were used in traffic forecasting models. Recently, however, some researchers have focused on the role of time expenditure on travel and the concept of travel budgets has been developed.

Travel Budgets

A person's use of time over a given period is termed his time budget. An exhaustive study of time budgets would include determining the duration, sequencing and the fixation in time of the activities (Anderson, 1971). Transportation researchers have naturally focused on the time devoted to travel and they employ the term 'travel budgets'. These may or may not include money expenditure.

Two approaches to travel budgets have been taken (Gunn, 1981). The first is an attempt to improve the forecasting of trip destinations for calibrating traditional travel forecasting models. Travel budgets are viewed either as constraints on the amount of travel a person will undertake or, alternatively, as a mechanism for decision making and utility maximization (Kirby, 1981). If travel budgets are to be incorporated into forecasting models it is important to determine whether or not the budgets are stable over time. Analysis of a number of surveys suggests that stability occurs at an aggregate level but not at an individual level (Gunn, 1981; Prendergast and Williams, 1981; Wigan and Morris, 1981). Attempts have therefore been made to categorize individuals with similar travel budgets. It is proposed that time devoted to travel increases with income but that there is a saturation level. As well, age, sex, stage in life, and employment status influence travel budgets (Goodwin, 1981; Wigan and Morris, 1981; Gunn, 1981). Until the concept is developed further, time budgets will probably be of use in traffic forecasting only at a macro level.

The second approach to travel budgets is to view travel patterns as part of total activity patterns. Implicit in this view is the following idea (Wigan and Morris, 1981, p.64):

> "Almost all transport movement is a derived demand, as comparatively little movement is undertaken simply for its own sake. The activities at the end of - and in some cases during - travel are the causal factors which determine the direction, intensity, pattern, timing and demand for travel of different types."

To participate in an activity the individual's space-time prism must include sufficient time to travel to the destination, partake in the activity, and return to the origin or go on to the next activity. Blocks of time available for undertaking activities are termed 'windows'. The size of window and the time of day in which it occurs greatly affect the ability of an individual to engage in activities. From a transportation point of view, the window must be large enough to allow the necessary travel and it must occur when the travel is possible. Therefore, scheduling of transportation modes must be complementary to the scheduling of activities. Those people with access to automobiles generally have more flexibility in scheduling departure and arrival times than do people dependent upon public transportation (Hemmens, 1966; Martensson, 1978). If frequency of public transportation is low it may not be possible to reach the activity within the available time window, or the associated wait times may be so great that the time and money expenditures are not worthwhile. If activities begin or end early in the morning or late at night, public transportation may not be available at all.

Some research has been undertaken on the interrelationship between mode of travel and the associated activity. Most of this work has been done in Scandinavia, probably as a result of Hagerstrand's lead. Two examples are Martensson's study of opportunities for people from different sized towns to engage in activities, and Jensen's study in Denmark of the value of excess travel time. Martensson (1978) concluded that many activities are not possible for people who depend upon public transportation because the available window of time cannot accommodate the necessary travel and wait times. Jensen (1978) concluded that the length and importance of the associated activity and the location where the waiting time is spent determines the value of the excess travel time. Waiting time is of lower value if either the activity is obligatory or the waiting time can be spent pleasantly.

Jones (1977), arguing in favour of the second approach to travel budgets, suggested that the use of activity systems will permit the problem of latent demand to be adequately addressed and will provide a means for estimating the effect of institutional and technological changes on travel patterns. In summary, activity systems are a framework for research which should provide a deeper understanding of travel needs and travel behaviour.

PUBLIC TRANSPORTATION PLANNING

Public transportation planning research has focused on modal split, which is the percentage of travellers using each mode of travel. The research has developed from a simple description of the spatial, temporal and socio-economic characteristics of transit demand to complex modelling of the users' time, comfort and convenience utility functions.

Socio-Economic Factors of Modal Split

Captive riders (i.e., those people who do not have access to an automobile for their trips) account for most of public transportation ridership. Most of these riders are females, the elderly and children. Studies in Toronto showed that 60 percent to 80 percent of riders are female. Passengers under 21 accounted for approximately 49 percent and passengers over 65 years of age accounted for 5-20 percent of total ridership respectively (Shortreed and Miller, 1980). The importance of household income, however, was unclear. Shortreed and Miller (1980) suggested that low-income households are likely to produce more riders than high-income households, but there is a base level of riders from all groups due to school trips and lack of access to a car. Williams' work in Buffalo suggested that, for work trips, household income is not a deciding factor in modal split but occupation is. White collar workers are more likely to travel by automobile. For shopping trips, however, household income does appear to affect modal choice (Williams, 1978). Certainly, car ownership, which may reflect household income, is an important factor in modal split (Pushkarev and Zupan, 1979; Williams, 1978).

Spatial Characteristics of Modal Split

Land use and density greatly affect the demand for travel and the use of public transportation. The higher the residential density, the more trips generated; the higher the concentration of commercial or office activity, the greater the attraction for all trips; the higher the density of residential, office and commercial usage, the greater the use of public transit (Pushkarev and Zupan, 1979). The relationship between density and transit usage also tends to be self reinforcing. The higher the concentrations of trip generators and attractors, the higher the level of transit sevice provided. In turn, the higher the level of service, the more attractive is the system. Hence, usage is likely to be greater. For example, the central business district (CBD) typically has the largest concentration of jobs, services, and commercial activities. Most transit systems have a radial network of routes focusing on the CBD. Usually transit ridership to the CBD is higher than to any other part of the city.

City size also affects ridership. The larger the city, the higher the transit share of modal split is likely to be and the lower the elasticity of demand for service. Pushkarev and Zupan (1979) suggest that alternatives to public transit are more available in smaller cities where land use is less dense and congestion less severe.

Two further spatial factors of public transportation are the connectivity of the system and ease of access to the system. Ridership tends to be higher if a direct route is available to the destination. Patrons who must transfer to reach their destinations face the inconvenience of an additional wait for the second vehicle. As well, travel by public transportation is restricted by the coverage of the system. Usually the road system is far more extensive than the public transportation system. Because most systems are radial in nature, there tends to be a low transit usage to areas outside the CBD.

Ridership studies revealed that patronage drops off quickly as walking distance to boarding points increases. A survey of bus patrons in North Edmonton showed that 81 percent walked less than 1000 feet (approximately 300 meters) to a bus stop (Gill, 1969). Pushkarev and Zupan (1979) suggested that the distance people will walk varies inversely with income and directly with residential density. Fruin (1980) argued that walking distances are more dependent upon purpose, time of day and the walking environment than upon the energy expended. Age and health, however, will be important factors. Many researchers have suggested that walking distance should be measured in minutes rather than in feet or meters.

Temporal Characteristics of Modal Split

Traffic levels and public transportation ridership are highest during morning and evening 'rush hours' when people are travelling to work or to school. During rush hours - usually from 6:00 a.m. to 9:00 a.m. and from 3:00 p.m. to 6:00 p.m. on weekdays - over half the daily ridership occurs. Within these hours there are often 'peak hours' when ridership is concentrated. In Edmonton, Transit Department records showed that the greatest patronage occurs between 7:30 a.m. and 8:30 a.m. and between 4:30 p.m. and 5:30 p.m. Ridership tends to be low in mid morning, increasing towards late morning and early afternoon. It then tapers off after the evening rush hours and is usually very low in late evening and night hours.

Ridership also varies with the day of the week and the time of the year. It is highest on weekdays, significantly lower on Saturdays, and lowest of all on Sundays, when the demand may be deemed too low to warrant service. Seasonal variation in Canada means that ridership is highest in winter months and lowest in July and August (Shortreed and Miller, 1981). In cities with universities, ridership is highest during university terms.

Service levels reflect this revealed demand. The most frequent service is offered during peak hours on week days; the least frequent service is offered at night and on Sundays and holidays. In addition, service is often reduced during summer months.

THE ROLE OF TIME CONSUMPTION IN MODAL SPLIT

As transportation research progressed, more and more emphasis was placed on the consumption of time in travel. This began as an attempt to determine modal split and evolved into a study of travel as one component in an individual's complete time budget. That, in turn, led to some of the more complex concepts of the utility of travel and travel budgets.

Initially, travel time was given a fixed dollar value, usually equal to the minimum hourly wage or the hourly wage of the various income groups under study. Aggregated monetary values of travel time savings were often used in cost benefit analysis of transportation facilities. For example, travel time costs were used in the cost-benefit analysis for the Third London Airport (Lichfield, 1971). Frequently, however, the result exaggerated the value of time saving and, in turn, the advantages of the transportation facilities were overstated. From further research it was concluded that the various stages of a trip should be valued separately and that people have differing values of time (Domeneich *et.al.*, 1968; Fruin, 1980; Klein, 1968).

Each trip made in a motor vehicle is comprised of the following components: a walk to the vehicle, time spent in the vehicle, and a walk from the vehicle to the final destination. Trips that involve the use of public transit also include a wait for the vehicle. If transfers between modes or routes are required, an additional wait and possibly an additional walk are required. Researchers have attempted to determine the value of time spent at each stage of a journey. Rather than define explicit money value for each block of time it is more accurate to determine either the effect of time on the elasticity of travel demand or the relative value of time.

Excess travel time (that is, the time spent walking and waiting) is valued two to three times more than time spent in a vehicle. Klein (1968) suggested that waiting is more onerous than walking and the cost of both waiting and walking increases with exposure to weather and with duration. Pushkarev and Zupan (1979) studied elasticity of demand and concluded that a reduction in excess time would be at least twice as effective in increasing ridership as a decrease in in-vehicle time, and that a reduction in any part of travel time is two to three times as effective as a decrease in fares. They also found that elasticities of both fare and travel time are greater for smaller urban centres than for large ones, and they attributed this to the greater attractions of alternative modes in the smaller cities. Horowitz (1978) developed a cardinal scale of subjective values of travel times of Chicago residents. He concluded that time spent on short trips is valued equally whatever mode is used. However, as the trips lengthen, time spent walking becomes more costly. Time spent on travel to work is given a higher value than time spent on recreational trips. He also concluded that environmental conditions (i.e. weather, congestion and the availability of seats on buses) affects the subjective value of time.

Williams (1978), in a study of Buffalo, New York, investigated walk, wait, transfer and in-vehicle times, as well as the monetary cost of trips. He concluded that initial waiting time is less important for work trips than either walking or transfer time. Cost and in-vehicle times are not important determinants of modal split. Occupation, however, is; white collar workers opt for automobiles. For non-work trips walking times are most important. Williams suggested that the inconvenience of carrying parcels is the main reason. Family income and the number of cars owned by the household are also important.

The planning implication of these studies is that the most promising way of increasing modal split is to reduce travel time, in particular excess time. Waiting time can be reduced by increasing frequency of service. Decreased walking time can be achieved by a denser network of routes, by direct walking access to bus stops, or by higher density development close to bus stops or train stations. Improvements in the walking and waiting environments (for example, well-lit sidewalks and shelters at stops) will also reduce the subjective value of excess time. Once a residential area is built it may be difficult to improve access to transit services. Only certain streets are suitable for bus traffic making it impossible to provide a denser network of routes. Neighbourhood design might preclude direct walking access or provision of adequate sidewalks, and changes in development density are often difficult to achieve. Therefore, accessibility to public transportation must be carefully considered in the design stages of residential areas.

ACTIVITY SYSTEMS AND PUBLIC TRANSPORTATION PLANNING

Activity systems can be used as a framework for public transportation planning, although this approach has seldom been used in the past because the complexity of the links between activities and travel has hindered model development. Using the concept should aid researchers to understand the relationship between participation in activities and the ability of the public transportation system to meet travel needs. Both the sociological and the constraints approaches to activity systems are relevant.

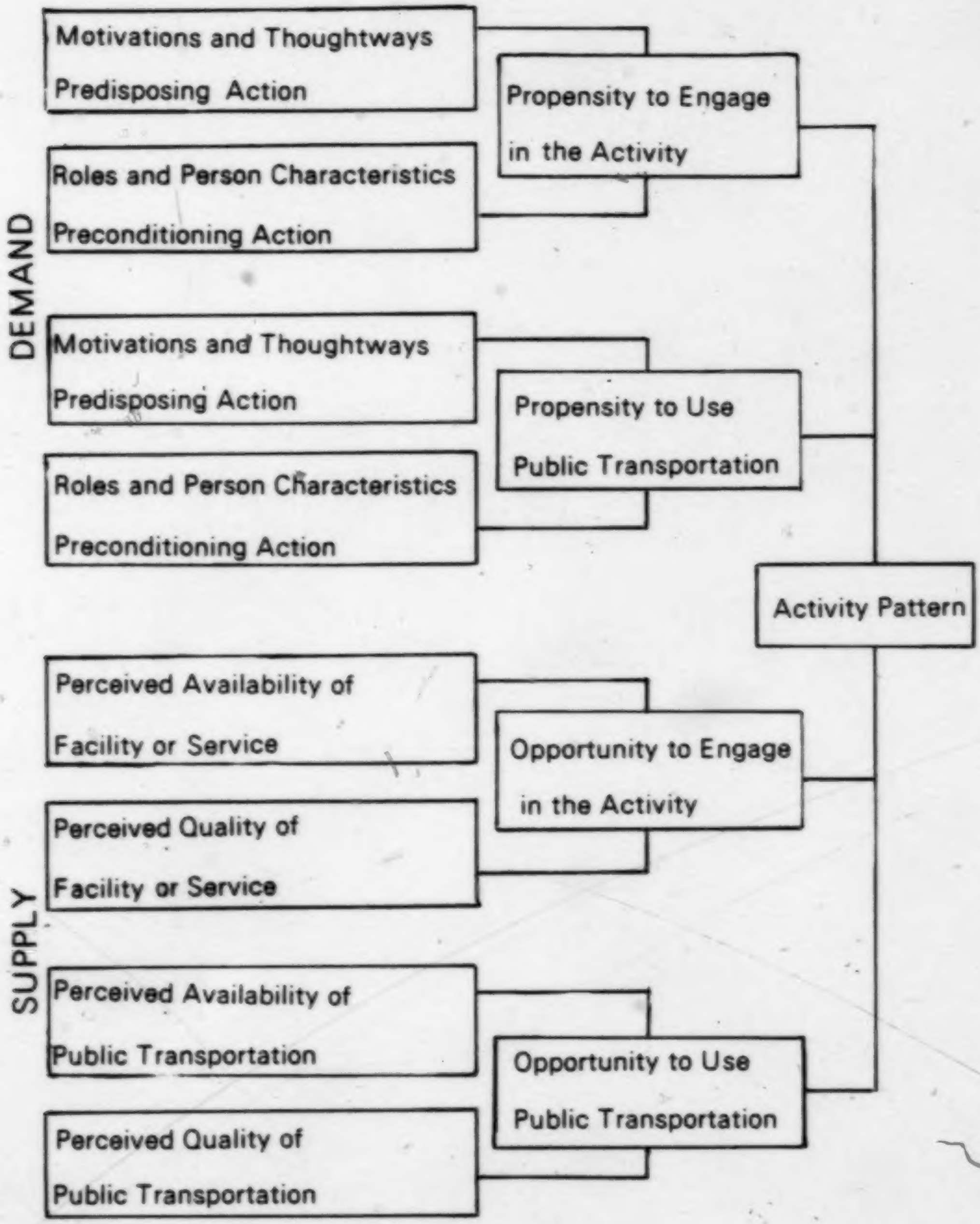
A Sociological Approach to Activity Systems and Public Transportation Planning

Chapin's model (Figure 1) does not distinguish between activities and the associated travel, but the perceived quality and availability of transportation systems are important determinants of the opportunities to engage in activities. Temporal and spatial characteristics of modal split indicate how the perceived public transportation system affects the supply and range of opportunities for individuals who rely on public transportation to partake in activities. In the upper portion of Chapin's model, motivations, thoughtways, roles and person characteristics predispose and precondition actions which influence the propensity to engage in activities. In a similar way these factors affect the demand for public transportation. The socio-economic characteristics of public transportation users fit into this half of Chapin's model.

The application of this model to public transportation research is not a simple matter of exchanging 'activities' for 'public transportation', because that would suggest travel was an activity undertaken for its inherent value. What is required is an additional layer in the model to explain the demand and supply of public transportation services (Figure 5). A web of interaction exists between the two layers because the activities influence the demand for public

FIGURE 5

AN ADAPTATION OF CHAPIN'S GENERAL MODEL
FOR EXPLAINING ACTIVITY PATTERNS


DEMAND
Motivations and Thoughtways Predisposing Action
Roles and Person Characteristics Preconditioning Action
Propensity to Engage in the Activity
Motivations and Thoughtways Predisposing Action
Roles and Person Characteristics Preconditioning Action
Propensity to Use Public Transportation
Activity Pattern
SUPPLY
Perceived Availability of Facility or Service
Perceived Quality of Facility or Service
Opportunity to Engage in the Activity
Perceived Availability of Public Transportation
Perceived Quality of Public Transportation
Opportunity to Use Public Transportation

Source: Modified from Chapin (1974) p.33

transportation, and the availability of public transportation limits the opportunities and the propensity to engage in activities.

A Constraints Approach to Activity Systems and Public Transportation Planning

Hagerstrand identified three major types of constraints: capability, coupling, and societal or domain. Capability constraints limit the accessibility of public transportation systems. Modal split studies have shown that the most frequent users of public transportation (i.e., the young and the aged) are also those who find that the length of the walk to the boarding point can most restrict their opportunities to use the system. Capability constraints are also encountered when passengers are carrying parcels.

Coupling constraints take the form of coordinating individual and public transit service timetables. Studies mentioned earlier showed how windows of available time constrict opportunities to partake in activities. Societal constraints are found in government decisions, such as whether or not to provide public transportation and the level at which service should be offered. As well, public and private institutions affect the attractiveness of competing travel modes through parking availability, tax exemptions for business use of cars, and regulations governing the hours and location of employment, shopping, education and recreation. Hagerstrand also noted that every action is affected by past actions. Previous experiences of using public transportation will influence the decision to use the mode again. This 'feedback' is similar to Chapin's 'perception' of opportunities to engage in activities.

A thorough understanding of capability, coupling, and societal constraints facing public transit users or potential users should allow the planner to design a system that will increase the accessibility of activity opportunities and so restrict the space-time prism as little as possible. As well, the planning authorities can make 'priming decisions' which encourage activities to locate in areas served by public transportation, allowing the individual's 'secondary decision' to include the use of public transportation in reaching the chosen activities.

One focus of the thesis is the effect residential design has on the use of public transit. Capability constraints (for example, walking distances from the home to the bus service) are likely to be most affected by residential design at the neighbourhood level. As the planning scale increases, however, coupling constraints such as the co-ordination of public transit service and commercial, educational, employment and recreational land uses become more important. The impact of residential design on preconditioning and predetermining characteristics of transit users is limited to influencing the type of person attracted to the housing available in the residential area. However, the perceived availability and quality of transit service is influenced by the accessibility of transit service which is certainly affected by residential design. In this thesis, then, Hagerstrand's concept of activity systems tends to be emphasized but the sociological perspective is not ignored.

CHAPTER 3

SUBURBAN RESIDENTIAL PLANNING: PRINCIPAL DESIGN CONCEPTS

The interdependence between land use and transportation was established in Chapter 2. Land use determines the need for transportation to various activities but it has become increasingly clear that urban form is dramatically influenced by transportation modes. The effect of changing transportation technology, coupled with an increasingly urban population, can be seen in the rapid expansion of cities in the late nineteenth and the twentieth centuries. When travel was limited to pedestrian and horse modes, cities were necessarily compact and densely inhabited. The introduction of commuter railways and tram cars allowed cities to expand along the transportation corridors with bead-like development occurring around railway stations and lineal development occurring along tramways. The invention and ensuing widespread ownership of the automobile allowed development to fill in between rail and tramlines, as well as to extend further and further into the surrounding countryside, requiring more and more land for roads. The explosive growth of cities with an accompanying overcrowding of the urban population and, later, the tyranny of the automobile stimulated architects, philanthropists and planners to propose ways of restraining, directing and accommodating urban development in order to create healthy, safe and convenient environments.

The concept of activity centres was implicit throughout these proposals. The planned areas were intended to provide for all residential needs, offering facilities to accommodate the various activities of the residents, so transportation was a major consideration. However, the complexities of transportation planning and the special engineering skills required to develop transport rights-of-way and facilities has resulted in a separation between transportation and land use planning, although they follow parallel lines.

THE EVOLUTION OF SOME SUBURBAN PLANNING CONCEPTS

To understand the role of public transportation in suburban residential areas of today, it is necessary to trace the evolution of planning concepts which created distinct suburban units. A review of some of the most significant of these concepts follows, beginning with Howard's proposals for 'Garden Cities' and ending with the current practice of sector planning in Edmonton, Alberta.

The Garden City

Howard (1902) suggested the growing urban population should be housed in new 'Garden Cities' where the advantages of town and country could be combined. In the diagrams through which he illustrated his garden city principles, Howard adopted a radial-concentric street pattern with wide boulevards penetrating rings of industry, homes, retailing and parks to reach the civic core. The cities were also to be small and compact, however, and their radius of three-quarters of a mile was designed on a pedestrian scale. Rather than allow individual cities to expand into the countryside, Howard proposed that they be grouped in controlled constellations comprising a central city encircled by a green belt and a ring of smaller satellite garden cities, each of which would also be protected by a green belt. This Howard referred to as the social city. An inter-municipal railway system was proposed to link the cities.

Howard's idea of self-contained garden cities with large parks and limited in size by greenbelts became the basis of British new town planning. Reiner (1963) also suggests that the division of the cities by the penetrating boulevards was a precursor of the neighbourhood unit concept. The physical separation of industrial, shopping, residential and civic activities is present in most later plans too.

The Garden Suburb

In a modified form, the garden city concept was also applied at a suburban level, beginning in 1905 with Hampstead Garden Suburb in London, England. This was planned to preserve the country within the city and to make pleasant green areas accessible to the common worker as well as to the wealthy citizen. A church square with school and other community facilities, was designed to be the focal point, offering a sense of community and city to the suburb. Unwin, the principal planner of Hampstead, wished to avoid needless internal traffic because he believed that streets were not in themselves a virtue (Creese, 1966). A road hierarchy of footpaths, walks, lanes, streets and roads was implemented, although it has failed to cope with the growth in traffic and circulation is a problem in Hampstead today.

Nonetheless, Creese suggests that Hampstead proved that garden suburbs had a place in urban planning and were a legitimate invention of the age.

The Superblock

In North America, beginning in the 1920s, the overpowering presence of the automobile led planners to seek ways of controlling automobile intrusions into residential spaces, while securing the environmental and social amenities of the garden city and garden suburb. In particular, Stein and Wright developed the superblock concept while Perry proposed the building of residential neighbourhood units.

Stein and Wright first introduced the principles of superblock planning into New York's gridiron street pattern during 1924 to 1928 with the building of Sunnyside Gardens (Stein, 1957). The intent of the development was to produce reasonably priced housing with an increased amount of effective open space and minimal intrusion by the automobile. Houses and apartments were built around the margins of standard city blocks, with small private rear yards, but the centres of the blocks were consolidated into common open areas. Garages were built in a compound away from the dwellings, thus introducing some separation of vehicles and pedestrians. Although public transportation was not considered in the design, Stein attributed the success of Sunnyside Gardens in part to the existence of nearby rapid transit.

The superblock design was further refined with the building of Radburn (1928-1933), outside New York City. Here, the influence of the garden city concept is more clearly seen. As Stein (1957, p.19) put it, he had "become a disciple of Ebenezer Howard and Raymond Unwin" but wished to build a new kind of garden city, "realistically planned for the Motor Age". The superblocks were bounded by main roads and partially penetrated by cul-de-sacs. With underpasses provided where the spinal parks and walkways intersected the roads, complete separation of pedestrian and vehicular traffic was achieved. Again, Stein and Wright did not consider public transportation in Radburn, but public transit could be imposed upon the plan with routes around the superblocks and boarding points where the park fingers met the roads. The original plan also included a town centre with a high school, a commercial centre with access to the railway, and neighbourhoods, one-half mile in radius, centering on elementary schools.

As a result of the depression, development was limited to three superblocks, only one of which came close to completion. Nevertheless, the 'Radburn Idea' - superblocks with parklands as backbones and complete separation of pedestrian and automobile traffic - was shown to offer a pleasant and safe residential environment.

The Neighbourhood Unit

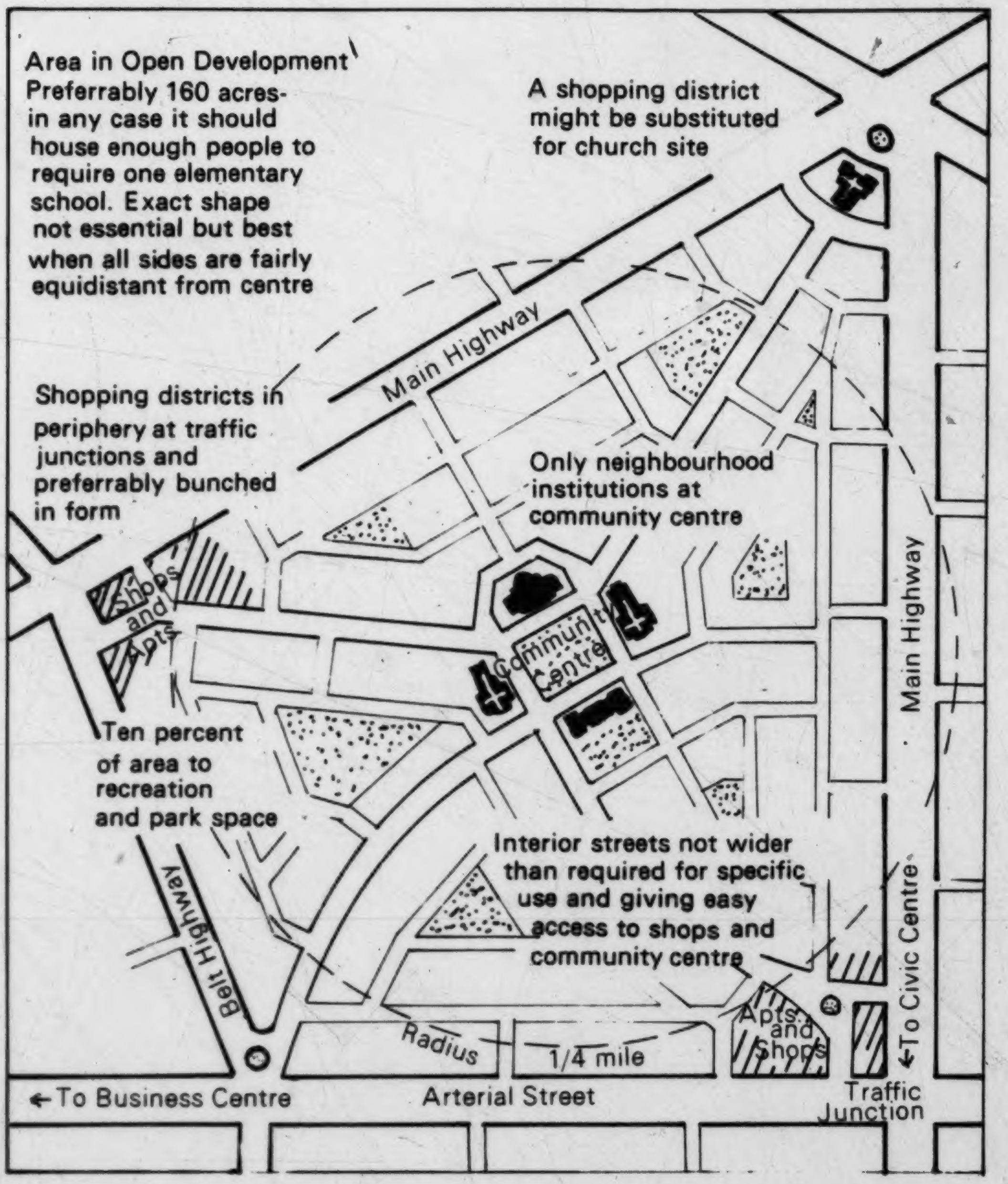
Also in the 1920s, Perry, concerned about the deteriorating environmental conditions in rapidly expanding cities,argued that residential areas should offer a sense of community and identity for their inhabitants, and should be organized to conserve family life. His proposal for recognizable neighbourhoods following six design principles has had a powerful influence on residential planning ever since (Perry, 1929; Figure 6).

First, said Perry, the size of the neighbourhood unit should be sufficient to support one elementary school. The physical extent would vary with the housing density but the walking distance to the school should not exceed one-half mile (800 meters). Second, the neighbourhood unit should be bounded by arterial streets which would serve the dual functions of allowing non-local traffic to bypass the neighbourhood and providing it with a distinct edge. Third, open spaces within the unit should offer a system of small parks and recreational areas, geared to the local needs of the residents. Fourth, community institutional sites should be concentrated centrally, acting as a focal point with convenient access to all. Fifth, local shops should be located on the circumference of the neighbourhood, at traffic junctions and, if possible, grouped with the shops of adjoining neighbourhoods. Sixth, the internal street system should be structured to facilitate internal circulation while discouraging through traffic, and every street should be proportioned to its probable traffic load.

The merits of Perry's neighbourhood unit concept were quickly recognized by planning theoreticians and practitioners (Winholtz, 1968, p.567). For example, Mumford (1954) suggested that it was the only practical answer for the dispersal of community service facilities in existing, over-centralized metropoli. Similarly, the American Public Health Association (1960, pp. 1-2) stated that "the existence of a unified neighbourhood is a strong force for the stability and development of individual and family life." Acceptance

FIGURE 6

THE NEIGHBOURHOOD UNIT CONCEPT


Area in Open Development Preferrably 160 acres- in any case it should house enough people to require one elementary school. Exact shape not essential but best when all sides are fairly equidistant from centre
A shopping district might be substituted for church site
Main Highway
Shopping districts in periphery at traffic junctions and preferrably bunched in form
Only neighbourhood institutions at community centre
Shops and Apts
Community Centre
Main Highway
Ten percent of area to recreation and park space
Interior streets not wider than required for specific use and giving easy access to shops and community centre
Belt Highway
To Civic Centre
Radius 1/4 mile
Apts and Shops
← To Business Centre
Arterial Street
Traffic Junction

Source: Modified from Perry (1929)

of the neighbourhood unit concept was said to imply that "all residential and community facilities and services required for the shelter, health and convenience of the residents of a neighbourhood must be included in a neighbourhood - or must be made available to its residents." Then, in an important modification of Perry's principles, the American Public Health Association (1960, p.72) reccommended that all community facilities, including the neighbourhood shopping centre, should be "grouped together in a central location . . . connected to the residential parts of the neighbourhood by direct automobile and pedestrian routes." This, it was thought, would provide the neighbourhood with a focal point that would encourage the fullest use of facilities and strengthen community relationships. At the same time, Rasmussen (1957), pursuing a theme developed first by Mumford (1949), cautioned that neighbourhood design should be flexible enough to accommodate the needs of the different age groups destined to live in the area, because spheres of activity vary with age and stage of life.

Cities in the Suburbs

As a physical planning concept, the neighbourhood unit comprises a well-defined area focused upon an elementary school with safe pedestrian access to facilities located within the neighbourhood. Commercial enterprises intended to serve the neighbourhood were included in the concept as well, but it was eventually learned that a single neighbourhood could not generate business on the anticipated scale. As car ownership and personal mobility increased, locally oriented shops, unable to compete with shopping centres, came to be replaced by higher order establishments which could attract customers from wider areas (Harasym and Smith, 1975). Secondary schools, medical facilities, libraries and entertainment facilities also required a threshold demand larger than that available in the neighbourhood. The American Public Health Association (1960) recognized that employment and some regularly required facilities would not be contained within the neighbourhood; adequate transportation to these activities was therefore required.

Carver (1962) carried this theoretical development a step further, by arguing that a critical, new level of urban residential planning on the scale of a town was necessary in order to support the social and community facilities required by suburbanites. This would also allow the systematic provision of services and facilities on a hierarchical basis. Carver suggested that three or four neighbourhoods, organized as in Perry's concept around the elementary school, should be grouped to form a higher-order community - what Carver called "a city in the suburbs". This, in turn, would be focused on a "town centre" which would offer civic, cultural, medical and recreational facilities, as well as a high school and a major commercial centre. The town centre would provide an identity for the suburb and encourage a sense of community among its residents. In effect, the garden suburb was expanded to the scale of the garden city, and Carver fully acknowledged these influences on his thought.

While Perry proposed that neighbourhoods should be designed at a pedestrian scale, cities in the suburbs require vehicular transportation, both private and public. Carver suggested that adequate parking space would be required on the margins of the town centre, but within the centre the pedestrian scale was thought to be more appropriate. He also thought that the concentration of service activities in one area, with higher density housing clustered around it, would be advantageous for public transportation.

Carver's proposals were essentially an articulation of planning practices that were evolving in both Britain and Canada. The British new towns were organized on a well-defined service hierarchy and Carver suggested this principle should be applied to suburban expansion, as had already been done in Don Mills, Toronto.

Don Mills, Toronto

Don Mills, planned in 1952, incorporated five design elements that had not been tried in Canada before (Sewell, 1977). First, a hierarchical structure was imposed on the residential areas. Neighbourhoods were centered on elementary schools, and four neighbourhoods were arranged as a community focusing on a 'town centre' which had regional shopping facilities, a high school and a library. Second, vehicular and pedestrian paths were separated on the Radburn principle, with walkways leading to schools and to the town centre. The street system restricted through traffic; intersections were 'T' shaped except where the arterials crossed in the town centre. Third, green spaces were a dominant part of the plan. Fourth, employment opportunities were provided by the inclusion of a high class industrial area. Fifth, serious consideration was given to aesthetic and architectural elements of the design.

Sewell contends that Don Mills became the prototype for suburban design throughout Canada. Many contemporary suburban developments contain a hierarchy of residential units, a town centre with arterial access and surrounded by town houses and apartments which act as a buffer for single family dwellings, a hierarchical road system where non-residents' cars are discouraged but the use of cars by residents for shopping and recreation is accepted and accommodated, and the incorporation of open green space as a dominant feature of the design. There have also been attempts to copy the industrial-residential mix found in Don Mills, although Sewell maintains that they have not been successful.

SUBURBAN RESIDENTIAL PLANNING IN EDMONTON

These changing scales in residential planning are also to be seen in the development of Edmonton. Undifferentiated grid development gave way to neighbourhood units and, eventually, to the 'cities in the suburbs' concept.

Use of Neighbourhood Units

In Edmonton, the neighbourhood unit concept was adopted for residential development as early as 1950 (Chan, 1969). The Central (now Canada) Mortgage and Housing Corporation was then promoting the advantages of planned unit development as well, and the Alberta Subdivision and Transfer regulations already incorporated principles that were fundamental to the neighbourhood unit concept. These principles included the designing of roads proportioned to their probable load in order to insure safety and privacy, the dedication of reserve land for school and park purposes, and convenient relationships among the elements of the neighbourhood.

The Edmonton neighbourhoods closely followed Perry's concept. In the first ones, commercial enterprises, community activities and higher density housing were concentrated near the centres of the units but later, as in Perry's own diagram, the multiple family housing and the shops were placed at the perimeter in order to reduce traffic intrusions and to increase exposure for the shops. The neighbourhood units then focused on elementary schools and community playing fields that were within easy walking distance of the dwellings. Arterial roads bounded the units, defining their limits. A curvilinear system of internal roads, with limited access from the arterials, discouraged through traffic. Rear lanes accommodated utilities and gave access to individual properties.

The City of Edmonton owned large tracts of land within its boundaries as a result of the land reverting to city ownership for non-payment of taxes following the collapse of an early land boom (Dale, 1969). With a near monopoly on land, and the design, phasing and approval of neighbourhood units all being done by civic departments, the City was able to contain the planning of residential growth within its own administration. The City consistently followed the neighbourhood unit concept in the development of 41 neighbourhoods between 1950 and 1963.

The Outline Plan Concept and the Hierarchy of Plans

By the end of the 1950s the City had committed most of its own land to development. The initiative, therefore, passed to private developers, and with that came two changes in the approach to suburban residential planning (Graden, 1979). First, the City changed the focus of its attention from detailed design work onto schematic generalities through the 'outline planning' procedure. This was introduced in 1963 when the Municipal Planning commission began to require outline plans to be drafted before detailed subdivision plans could be considered for approval. Second, the notion of a hierarchy of plans, which was explicit in the Commission's policy, was expanded to include a larger 'district' unit. As Graden (1979, p.48) describes it:

> "Intuitively, Edmonton planners felt that individual neighbourhood units could no longer be designed in isolation and that the neighbourhood was not necessarily a self-contained unit particularly in terms of commercial retailing."

The suburbanization of retail outlets to shopping malls, and the greater accessibility gained from increased ownership and use of the automobile, reinforced this 'intuition'. The neighbourhood unit was not being rejected, but the planners had come to believe that it should be complemented by a "community service unit larger and more realistic than the Perry neighbourhood" (Graden, 1979, p.70). These ideas were later incorporated in the 1971 Edmonton General Plan, which set down a hierarchy of four residential planning scales - the district, the community, the neighbourhood and the subdivision.

The district outline plan: As defined in the 1971 Edmonton General Plan (City of Edmonton, 1971a, p.17.4), a district outline plan was

> "A broad, land use and transportation plan which establishes the distribution of major uses throughout an area, with the fundamental objective of providing a framework beyond which detailed subdivision may be based."

An outline plan could be prepared by a development firm or by a city department, but in either case city council approval of the plan was required. The plan was to include a forecast of the district's ultimate population, a calculation of utility requirements, a broad definition of the transportation system, including public transportation, and a schematic depiction of residential, commercial, institutional and recreational land uses. Particular attention was to be paid to the areas of public responsibility. Neighbourhoods within the district outline plan area were to be defined and a schedule of development was to be proposed. Subsequent, more detailed planning would then follow at a neighbourhood or community level. In brief, the purpose of a district outline plan was to establish terms of reference that would co-ordinate the planning of development at a large areal scale, avoid duplication of services, and ensure that incompatible land uses would not be juxtaposed.

A district outline plan area was normally to be large enough to comprise several communities, each centered upon a junior high school and, in some cases, a community level shopping area. A 'town centre', usually located at an intersection of two arterials, was to be the focal point of the outline plan district. Employment, entertainment, shopping, public services and high density housing were to be concentrated in the town centre and the senior high school was to be located in close proximity. The purpose of the town centre was to create a miniature city centre, adding an identity and sense of place to the plan area without being in competition with the central business district.

The neighbourhood outline plan: Neighbourhood outline plans were to be based on an approved district outline plan, but the anticipated form of development was to be shown in greater detail. The requirements of the plan included a statistical breakdown of existing and proposed land uses; population and student generation figures; the location and staging of roadways, walkways and services (Municipal Planning Commission Minutes, March 16, 1972); and "the proposed bus routes, through or bypassing the Neighbourhood including the proposed location of bus stops" (Municipal Planning Commission Minutes, April 6, 1972).

The elementary school remained the focus of the neighbourhood and was to be located near the centre in conjunction with a large park area. Small amenity parks or 'tot lots' could be located throughout the neighbourhood, although rising maintenance costs have tended to reduce their appeal for the civic administration. Housing could include detached and semi-detached homes, row housing and walk-up apartments, with the multiple family housing to be concentrated in the centre of the neighbourhood close to schools, parks, community league facilities, convenience stores and public transit. In 1972, it was further stipulated that 5 percent of the population in all future neighbourhoods should be accommodated in public housing. Commercial land uses were restricted to one or two small groups of convenience stores and were to be located centrally, often adjacent to the school and park site.

The General Plan stipulated that the internal street plan "should provide efficient access to all parts of the neighbourhood. Non-local or through traffic should be eliminated in order to create a quiet and safe environment" (City of Edmonton, 1971a, 5.4). To achieve this a hierarchical road system was imposed. Arterials formed boundaries, and access into the neighbourhood was limited to collector roads. Schools, parks, commercial sites and multiple family housing were adjacent to collector streets and public transit vehicles were limited to collector roadways. Local streets gave access to housing areas which were usually designed without rear lanes. Front drive garages were used to give access to individual lots unless "laneless subdivisions (were) uneconomical or otherwise undesirable" (City of Edmonton, 1971, 5.4).

The General Plan (1971a, 5.5) further stated that

> "Greater emphasis should be given to planning for the pedestrian in relation to the school and park systems, local shopping centres, bus routes, etc. Paved walkways should be constructed, and where necessary, pedestrian overpasses provided for safety and convenience if a major roadway is adjacent to pedestrian generating land uses".

The subdivision plan: The final, most detailed stage of planning results in the subdivision plan. Unless there have been unforeseen problems and changes in the housing market, it must conform to the neighbourhood outline plan (Graden, 1979). A subdivision plan provides information on lot boundaries, lot and block numbers, road design, bus stop location and utility layouts. The plan has to be approved by the Municipal Planning Commission before the owner can apply for rezoning approval and, eventually, for development and building permits.

The Example of Mill Woods

To illustrate the Edmonton residential planning procedure, and the physical planning concepts that have been employed, the example of Mill Woods will be briefly described. Mill Woods was planned in the late 1960s and early 1970s for an ultimate population of 120,000 (City of Edmonton, 1971b). Although most residential expansion in Edmonton was undertaken by private developers, the outline plan area of Mill Woods was planned by the City itself, as owner of the land. The goals and objectives of the Mill Woods plan strongly reflect those outlined in the 1971 General Plan, with respect to the quality of the residential environment. Four of the principle objectives were set out as follows; it should be noted that 'community' here has the same meaning as 'district' in the preceding section:

> "obtain an overlapping system of community structures based upon the economical provision and maximum use of community facilities and the fostering of community participation and development;
>
> focus the community onto an intensively developed central core incorporating the major social, cultural, and economic elements, serving as the main forum for community interaction;
>
> structure the community by relating circulation systems and land use patterns to effectively serve the various needs of the residents in a safe, efficient and economical manner;
>
> maximize the open space potential within the Mill Woods community to provide a high level of residential environment" (City of Edmonton, 1971b).

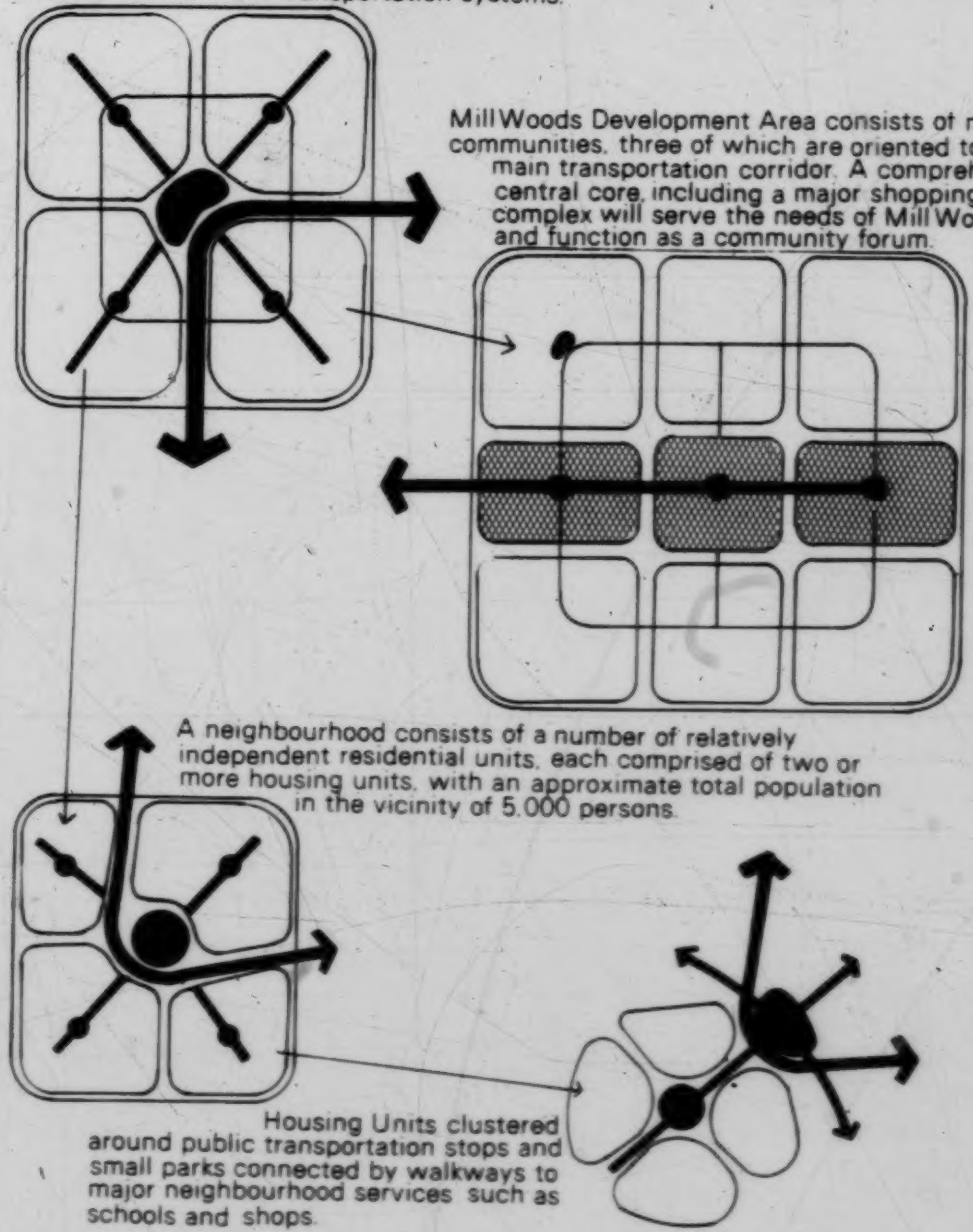
Arterial roads divided the full Mill Woods district into nine major units, also referred to as communities. Eight of these focused on a centre containing commercial enterprises, a junior high school and other institutional elements, while the ninth was to include the town centre. All centres were to have direct access for pedestrians and cars, and to be serviced by public transportation. Each community was further divided by secondary roads into three or four neighbourhoods, each organized around a small centre consisting of an elementary school, convenience stores, and community facilities. The neighbourhoods, in their turn, were arranged with a number of residential units, each clustered around public transit stops and small parks and connected to neighbourhood services by walkways (Figure 7).

The town centre was intended to act as a regional centre containing high density housing, a high school campus, a hospital, and civic, commercial and recreational elements. The centre was to be

FIGURE 7

THE HIERARCHICAL ORGANIZATION OF MILL WOODS, EDMONTON

A community consists of three or four neighbourhoods encompassing a resident population of between 12,000 and 20,000 persons, focusing on a community centre related with Junior High School Facilities and served by efficient and convient transportation systems.



Mill Woods Development Area consists of nine communities, three of which are oriented toward main transportation corridor. A comprehensive central core, including a major shopping complex will serve the needs of Mill Woods and function as a community forum.

A neighbourhood consists of a number of relatively independent residential units, each comprised of two or more housing units, with an approximate total population in the vicinity of 5,000 persons.

Housing Units clustered around public transportation stops and small parks connected by walkways to major neighbourhood services such as schools and shops.

Source: Modified from City of Edmonton (1971) "Mill Woods Development Concept".

directly served by arterial streets at a focus of rapid transit and bus routes. Employment opportunities would be available in the surrounding industrial areas, in the town centre and in the community and neighbourhood centres.

The circulation in the development was designed with a road hierarchy including, at the upper levels, major arterial streets to provide rapid access to the development and collector roads to encourage inter-community movement while restricting movement through the communities and neighbourhoods. The car was to be 'accommodated' but not allowed to dictate design. Public transportation was expected to serve a higher than average modal split. Land use patterns, strategic positioning of routes and stops, and provision of rapid transit were to help achieve this objective. Pedestrian movements to neighbourhood and community centres and to public transportation services were to be accommodated and separated from vehicular movements.

The Mill Woods plan echoed Carver's proposal for a city in the suburbs, though on a substantially larger scale. A vibrant town centre was to provide an identity and a focus for the development. The well-defined hierarchy was similar to that found in British new towns, and Perry's neighbourhood unit concept, although integrated into the larger community and district structure, was still recognized as an integral element of residential planning.

ACTIVITY SYSTEMS AND RESIDENTIAL DESIGN

Proposals for garden cities, garden suburbs, neighbourhood units and 'cities in the suburbs' were developed before Chapin and Hagerstrand articulated the concept of activity systems, but the elements of that concept can be found in residential planning theory. The provision of facilities for residents' activities - both the availability and quality, perceived or actual - and the means of overcoming constraints in using the facilities are themes of the earlier work. As well, planners have attempted to create pleasant residential environments. To achieve these ends, planners have tended to favour the separation of land uses, increasing the need for travel but also concentrating a number of opportunities at any one destination.

Separation of land uses has also been used in an attempt to insulate residential areas from the intrusions of industry, commercial enterprises and traffic. Commercial enterprises have been concentrated on the edges of residential areas, or, when located within residential areas, clustered in neighbourhood, district, or town centres. Institutional, recreational and cultural facilities have been located with the shops with the intent that the centres will give an identity to the residential areas and in the belief that hierarchical dispersion of facilities is efficient and convenient. Centralization causes traffic to be more concentrated than if the facilities were spread throughout the residential areas. High density housing has tended to be located near the centres in order to maximize the occupants' accessibility to the central activities, but also to buffer lower density housing from the traffic and noise of the centres. Industry, probably thought to cause the most offensive intrusions for residents, has been removed entirely from residential areas. Workers, therefore, face commuting to their employment.

Howard, planning on a pedestrian scale, was able to separate the various urban activities without the worry of reducing accessibility. However, the automobile changed the planning scale. In the characteristic form of suburban development, urban facilities were separated to the extent that reliance on the automobile could not be avoided. The neighbourhood unit concept and district planning were attempts to balance the sprawl of suburbia, the availability of the automobile and the wish to segregate land uses with the need for accessible facilities. The neighbourhood and the larger district or community are essentially domains where the residents have access to many daily activities. The neighbourhood unit is organized at a pedestrian scale and is designed to reduce the amount of travel for the unemployed family members, that is, children and housewives. Trips to local shops, schools and playgrounds are short and along safe routes. District planning helps ease the travel burden by concentrating facilities that require higher population thresholds in district and town centres. Most employment, however, remains a daily activity which requires commuting over greater distances. The evolution of residential development from the neighbourhood to the larger scale of 'cities in the suburbs' is exemplified in the Edmonton experience. Activity systems have been incorporated in the City's planning policies although the concept has not been explicitly identified.

In summary, residential planning has attempted to create environments where residents can develop fulfilling activity systems. Hierarchies of service centres have been used in order to optimize access to urban facilities, and the separation of land uses has emphasized the need for well-planned transportation networks, catering to public transit no less than to private users. Although the private automobile is likely to remain an important part of North American suburban life, careful design of residential areas should be practiced to enlarge the time-space prisms of those residents who will have to depend upon public transportation.

CHAPTER 4

SUBURBAN RESIDENTIAL PLANNING: THE CONSIDERATION OF PUBLIC TRANSPORTATION

A major purpose of this thesis is to determine if and how the physical design of residential suburbs affects the use of public transportation in daily activity systems. In Chapter 2 the interdependence between activity systems and access to transportation was established. On the one hand, activity systems determine the demand for public and private transportation; on the other, the availability of transportation largely determines the accessibility of activity opportunities. Much of the cited research was concerned with the influence that public transportation routing and schedules can have upon activity systems, but, as was shown in Chapter 3, the question of the effect of the physical layout of residential areas on public transit demand and usage was seldom raised. While schedules, and routing to a lesser degree, can be adjusted, the residential area, once built, has little flexibility. Therefore, the desired role of public transportation should be carefully considered and planned for during the initial design and construction phases of residential development.

Chapin proposes that both a propensity and an opportunity to engage in activities are requirements of activity patterns. The latter of these two factors is determined by the perceived availability and quality of the service or facility and is more likely to be affected by residential design than is the propensity to use public transportation, which is largely determined by socio-economic characteristics and past experience. The perceived availability of service, in turn, depends upon knowledge of routes and timetables - factors that are not affected by residential design - and by the visibility of the system, which can be achieved by providing shelters and signs and by making a recognizable right-of-way for the service. The quality of service is determined by its frequency, comfort, cost, scheduling, excess travel time and total trip time. Of these, excess travel time and total trip time can be most affected by the design of the neighbourhood. A direct route with a minimum number of stops will reduce travel time, while a waiting and walking environment that is pleasant and safe will reduce the perceived excess travel time.

Hagerstrand and his followers emphasized the capability, coupling and societal constraints on activity participation. Coupling constraints associated with the use of public transportation result from scheduling of the service and the activities. They are affected by residential design to the extent that the density of the housing and the intensity of land use directly influence the demand for public transit, and hence the level of service that can be supported. Societal constraints are determined by residential design to the extent that the quality of the housing offered in the area will affect the social composition of the residents and so influence the number of potential public transit users. It is the capability constraints, however, that are most affected by subdivision design. The physical layout of the area will determine distance to public transportation and the ease of overcoming that distance. The land use structure will also affect the number of activities available within the residential area and determine the number of trips that must be made to areas outside the immediate neighbourhood.

This chapter identifies some planning concepts and practices that directly affect the provision of public transit in residential areas. These concepts and practices have largely been developed by transportation rather than land use planners, reflecting the parallel yet separate concerns of these two branches of city planning. The chapter concludes with a discussion of public transportation planning in Edmonton.

SOME TRANSPORTATION PLANNING CONCEPTS THAT AFFECT THE PROVISION OF PUBLIC TRANSPORTATION

Road Hierarchies

The idea that transportation networks should be organized in hierarchical fashion, designed to segregate traffic by its purpose, has been particularly common. Tripp (1942) proposed a road system that would divide London, England into precincts in order to reduce the number of accidents and to speed the flow of traffic. Tripp's hierarchy was comprised of three classes of road, two of which held the interest of vehicular traffic as the most important design element, while the third held the interests of pedestrians and local population and the need for pedestrian access to local businesses as most important. Le Corbusier similarly identified pedestrian paths as the lowest level of service, in a seven-tiered hierarchy that ranged up to regional roads leading into the city (Evenson, 1969). The United States National Committee on Urban Transportation (1958), in a somewhat simpler example, listed four classes of roads - expressways, arterials, collectors and local roads - excluding pedestrian paths.

For the development of residential sites, the Canada Mortgage and Housing Corporation (1981) has suggested a three-tiered system of arterial roads, collectors and local streets that owes much to Perry's neighbourhood unit concept (Figure 8). Its characteristics are as follows:

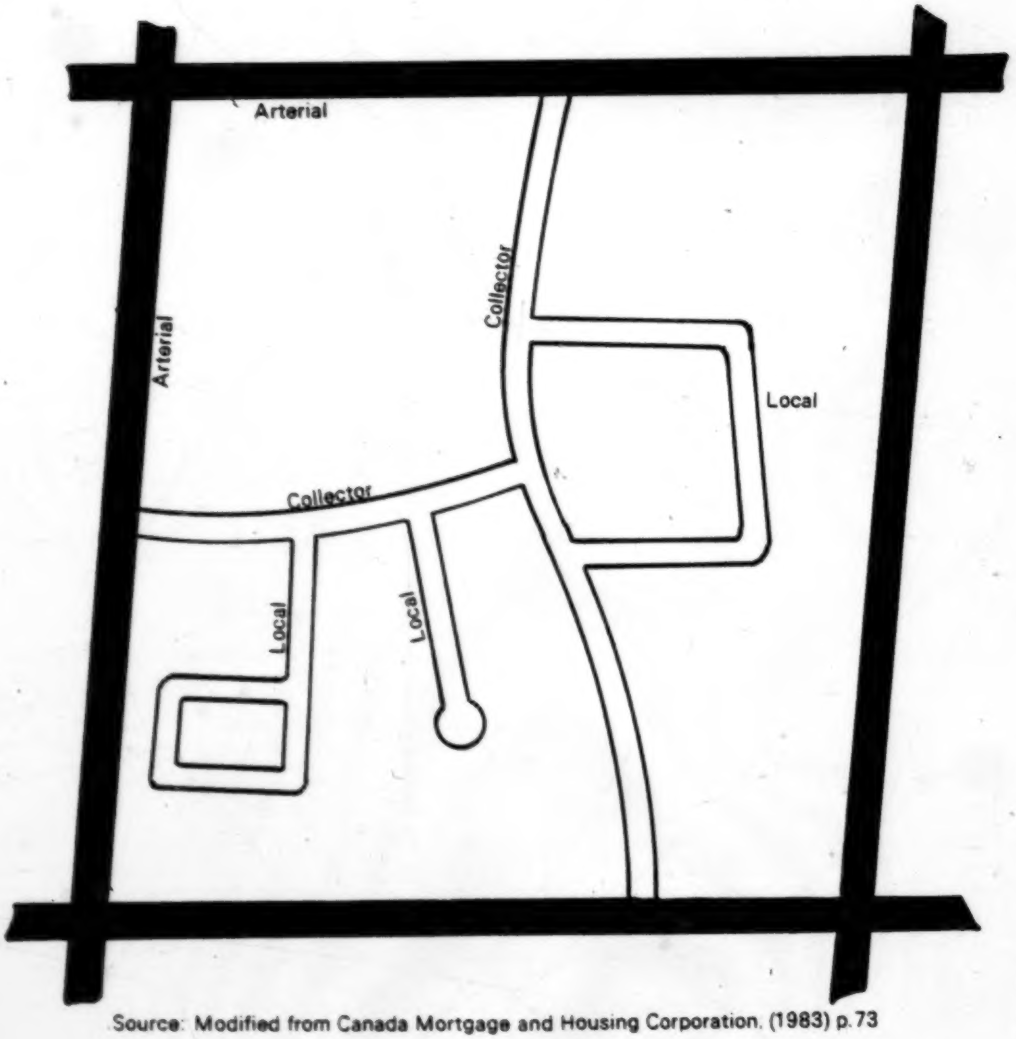
1. Arterial roads are designed to carry an uninterrupted flow of traffic at medium or high speeds (30 to 50 m.p.h. or 50 to 80 km/h). They provide connections between major traffic generators and form boundaries of neighbourhoods, institutional sites and commercial areas. Usually two or more moving lanes are provided; parking and unloading is prohibited; and pedestrian crossings are restricted. The use of bus bays, turning lanes and traffic lights to regulate traffic flow is common.

2. Collector roads connect local streets and arterial roads. Full access to bordering properties is allowed; parking may be restricted during peak hours; and vehicular speeds of up to 30 m.p.h. (50 km/h) are allowed. Intersections are controlled by stop or yield signs but not by traffic lights. Collector roads are used mostly by passenger cars and buses.

3. Local streets are designed to discourage through traffic, so they lack continuity. Average speeds are low - 10 to 20 m.p.h. (20 to 30 km/h) - but the distance travelled on local streets should be

FIGURE 8

CMHC RECOMMENDED ROAD HIERARCHY


Arterial
Arterial
Collector
Collector
Local
Local
Local

Source: Modified from Canada Mortgage and Housing Corporation. (1983) p.73

short. Since these streets provide access from abutting properties, access points and driveways should be safely located and designed. Local streets are intended for passenger and service vehicles exclusively and should not be utilized by regular public transit.

The imposition of a road hierarchy on city form affects the provision of public transportation by restricting the number of roads available to public transit vehicles. Expressways and the busiest of the arterials offer unsafe walking environments for transit patrons, and the free flow of high-speed traffic would be disrupted if transit vehicles were stopping and starting frequently on them. Within residential areas, public transit vehicles are restricted to collector roads. Hence the arrangements of these roads should balance the convenience of road continuity with first, the desire to discourage through traffic and second, the need to insure that residents have ready access to transit facilities.

Pedestrian Circulation

Residential planners have long recognized the need to segregate pedestrians from vehicular traffic to ensure safety. Stein and Wright advocated doing this with a completely separate pedestrian system, away from the roads. CMHC (1979), by contrast, has argued that sidewalks adjacent to roads are adequate. At night, they could actually be safer for pedestrians than separate walkways away from the watchful eyes of motorists.

The purpose of the pedestrian circulation system is to provide safe, pleasant journeys from dwellings to common destinations, activities and public transit stops (CMHC, 1981). Indeed, Golany (1976) has contended that a well designed system will increase the residents' propensity to walk. Such a system should be continuous, and free of barriers for wheel chairs and baby carriages, while minimizing the walking distances. The capital costs and maintenance of the system also have to be considered at the design stage (Ritter, 1964).

The American Public Health Association (1960) suggested a three-tiered walkway hierarchy. Entrance walks give access to individual or multiple dwellings. Service walks connect entrance walks to major walks which, in turn, provide direct access from main parts of the neighbourhood to community facilities, public transportation and pedestrian thoroughfares outside the neighbourhood.

Public Transportation

Planners have accommodated public transportation to varying degrees in their design concepts and principles. Thus, Howard, whose garden city was conceived on a pedestrian scale, recognized the need for public transportation for interurban travel; Le Corbusier saw public transportation as part of the overall transportation system in the very large city; and, on a smaller scale again, universal access to public transportation was the basis of the lineal city concept. In Soria's proposal for the Ciudad Lineal, 1882, houses flanked both sides of a spinal road on which ran an electric tramway (Creese, 1966). Since then, the lineal concept has been applied and adapted in a variety of ways. At the British new town of Runcorn, for example, the spinal road was looped to form a figure eight and it was reserved for public transit. This offered excellent pedestrian access to the transit services. Community centres and the town centre were designed as foci along the transit route. With particular reference to the place of public transit in suburban residential planning, the American Public Health Association (1960, p.9), in its handbook Planning the Neighbourhood, set down the following requirements:

> "All residents of the development area should have access to adequate public transportation to central business areas and places of employment, where these are not within easy walking distance. It is desirable that the farthest dwelling be no more than 1/4 to 1/3 mile walking distance from the nearest stop of the transit system over well-maintained, lighted all-weather walks. Steep hills or extremes in climate may call for a reduction of walking distance.
>
> The standards given above should be followed in all developments housing low and medium [income] groups, unless places of work are within walking distance and relatively complete neighbourhood shopping facilities tend to obviate frequent shopping at downtown centres. In this case public transit within 1/2 to 3/4 mile may be acceptable.
>
> Among the factors to be considered in evaluating public transit facilities are discomfort, inability to get a seat, time lost by frequent stops or transfers, risk of contagion in crowds and nervous strain caused by public noise."

Specific standards listed maximum public transit travel times as 15 to 25 minutes to a junior high school; 20 to 30 minutes to senior high schools, to district centres containing shopping, cultural, religious and recreation facilities, and to employment centres; and 30 to 45 minutes to the city centre.

At the same time, the American Public Health Association (1960, p.57) recognized that bus service within neighbourhoods has disadvantages:

> "As buses and trolleys are inevitably noisy, their presence close to dwellings is undesirable. It is preferable to route them on boundary streets just outside the neighbourhood. If it is necessary for buses or trolleys to run through the neighbourhood, they should be routed on the neighbourhood feeder streets and not be permitted on residential service streets. Increased dwelling setbacks should be provided on streets with buses or trolleys. For safety and convenience, additional street width will be required. Attention should be paid to provision of safety zones or islands at bus and trolley stops."

In 1979, CMHC produced a working paper with specific guidelines for facilitating transit services within residential subdivisions in Canada (CMHC, 1979). The guidelines were based on the premise that neighbourhood design should allow convenient public transit access for the greatest number of potential users. It was emphasized that walking distances, spacing of transit stops and the route to be followed should all be considered during the residential planning process. The guidelines are summarized below.

First, public transit routes should follow the collector road through the neighbourhood. This road should be positioned in a way that minimizes its length and yet gives maximum transit coverage, so as to reduce the operating costs and users' travelling times. The collector road here is comparable to the neighbourhood feeder street in the American Public Health Association's recommendations. If the transit route is determined during planning stages then adequate road and pavement rights-of-way and pavement and roadway base design can be insured. Hence, theoretically, prospective residents will know where the route is to be located, although some flexibility for future route changes could probably be accommodated.

Second, bus stops should be located to allow maximum patron access with a minimum number of stops because the speed of the service is reduced as the number of stops increases. A recommendation for stop spacing of 750 feet (250 m) or seven stops per mile (four stops per km) was made. This would allow an average speed of approximately 15 m.p.h. (24 km/h). If neighbourhood facilities are concentrated at nodes, bus stops can be co-ordinated with them. Shelters were considered desirable at stops but their influence on modal split was not thought to be great.

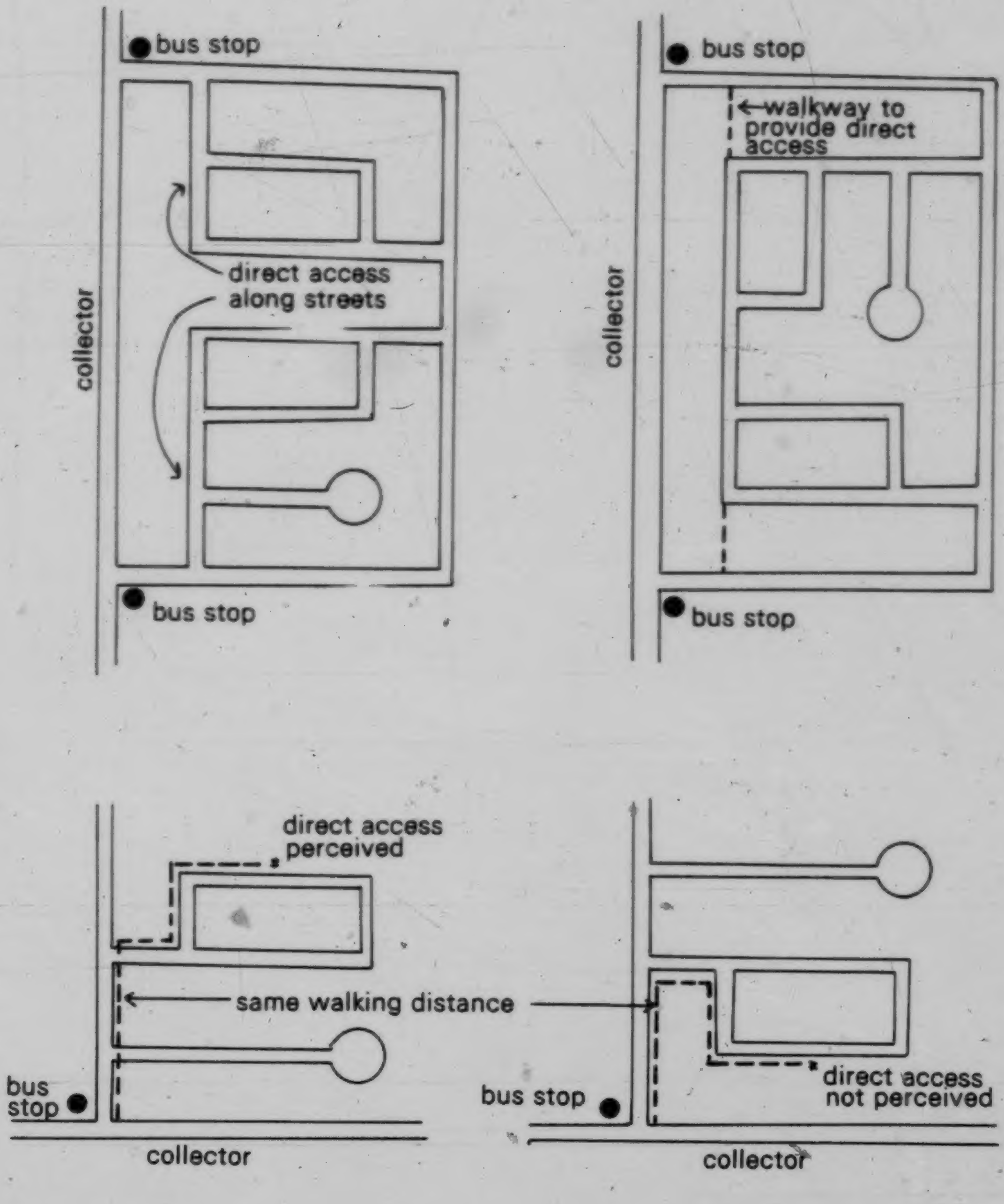
Third, walking distances should be minimized. It was suggested that a minimum of 40 percent of all users be within 660 feet (200 m) and a maximum of 15 percent of all users be beyond 1320 feet (400 m) walking distance of service. The guidelines also state that neighbourhood facilities, high density housing and housing for transit dependents - notably, low income families and senior citizens - should be located along the transit route, and that development should occur on both sides of the bus route in order to increase the density of users. These guidelines are therefore more stringent than those of the American Public Health Association. The CMHC guidelines also encourage the use of sidewalks adjacent to roads rather than separate walkways, since the latter are deemed to have greater capital and maintenance costs and to present problems of snow clearance in Canadian winters. If walkways are part of the neighbourhood design, they should serve multiple destinations and not be included solely for public transit access. Where sidewalks are not planned to flank all streets, consideration should be given to providing sidewalks along both sides of bus routes and along streets giving access to bus routes.

Because the guidelines discouraged the use of walkways it was strongly recommended that the street design allow direct access - both perceived and actual - to bus stops without the need to backtrack (Figure 9). Culs-de-sac and looped roads perpendicular to bus routes, and the placement of bus stops at intersections, help minimize walking distances. The guidelines also favour the penetration of shopping centres by bus routes, setting buildings close to bus lanes, and not locating parking lots between buildings and bus routes. Careful location of neighbourhood facilities and consideration of walking distances to bus stops, it was further suggested, could result in improved access to facilities for non-public transit users as well.

Finally, the report recognized that successful neighbourhood transit service is highly dependent upon external factors such as the distance to urban activity centres, the size of the downtown, and the levels of transit service offered.

FIGURE 9

LOCAL STREETS PLANNED TO PROVIDE DIRECT PEDESTRIAN ACCESS


bus stop
direct access along streets
bus stop
collector
bus stop
walkway to provide direct access
collector
bus stop
direct access perceived
same walking distance
bus stop
collector
bus stop
direct access not perceived
collector

Source: Modified from Canada Mortgage and Housing Corporation.(1979) p.38

TRANSPORTATION PLANNING IN EDMONTON

Metropolitan Edmonton Transportation Study (METS)

The first major transportation plan for Edmonton was the 1963 Metropolitan Edmonton Transportation Study. The study, which guided transportation planning priorities during the 1960s, concluded "that the most efficient and economical solution would be a system of 'freeways' in entirely new locations" (City of Edmonton, 1963, p.7). A system of new collectors and arterials would have fed five freeways radiating from the central core to the outskirts of the city. A freeway loop around the city core was also proposed to facilitate bypass traffic. The primary public transit objective was to increase usage to the downtown. It was therefore recommended that buses should be given priority entering freeways, and that park and ride facilities should be located at the access points. Public transportation was to attract new ridership rather than compete with the automobile. If public transit could not increase ridership to the central core, there would still be sufficient freeway capacity to handle the traffic.

The General Plan

Increased construction costs, escalating land values, and opposition to the planned freeways resulted in a shift in transportation policy. As early as 1967, in the first draft of the general plan, greater attention was paid to the interrelationship between land use and transportation, and a larger emphasis was placed on public transportation and pedestrian circulation. However, because City

Council could not agree on a transportation policy, the transportation chapter was initially omitted from the General Plan Bylaw, which was adopted in 1971. It was not until 1973 that City Council approval was given to the transportation chapter, but the principles set out in 1967 were generally adhered to.

The transportation objectives of the general plan were to develop a "safe, efficient, economic and equitable" system to meet the needs of all sectors of the community; to minimize deleterious effects of the system; to have the support of the public and city council; to be economically and technically attainable; to be flexible to future needs; and to achieve all this with "the minimum consumption of energy and other non-renewable resources" (City of Edmonton, 1971a, 12.2).

Public transportation received a much higher profile in the general plan than in METS. The need for convenient access by both automobile and public transit from living areas to work and leisure areas, public facilities and the downtown was stressed. The objectives for public transportation included the provision of "a high level of service capable of attracting and catering to heavy peaking travel demands to and from major activity centres and provision of mobility throughout the city" for public transit dependent users (City of Edmonton, 1971a, 12.5). Public transit was to attract a maximum number of passengers in order to reduce traffic congestion and parking requirements in the downtown; a rapid transit system was to be established; and land use development was to be guided in a "most advantageous manner with respect to future transit routes" (City of Edmonton, 1971a, 12.5). It was even hoped that public transportation would become the principal mode of travel to the central area and other major centres. To help achieve these objectives, new residential areas were to be designed with the interests of transit riders in mind. Schools, community centres, high density developments, commercial centres and churches were to receive priority service by buses. Population was to be concentrated near transit corridors and future rapid transit stations. Town centres, where rapid transit stations would be located, would provide a focal point for suburban service and have park and ride facilities. Finally, the public transit system was to be subsidized to attract riders.

Transportation Plan Part I

At the same time that the transportation chapter of the general plan was being refined in the early 1970s, work was proceeding on an expanded version that would eventually become a separate, more detailed transportation plan. The basic premises of this plan were outlined in a position paper in 1972 (City of Edmonton, 1972). The principal intention was to improve the existing transportation system rather than build a comprehensive new system as had been proposed in METS. The main exception was the inclusion of a rapid transit system. As well, a new approach to public transit was proposed (City of Edmonton, 1972, p.21):

> "Transit operations must be evaluated with respect to the levels of passenger traffic handled and the corresponding transportation system enhancement achieved. A broader look at the economics of a transit route, line or service will reflect its costs in terms of the equivalent in roadways or other facilities that

> would otherwise be required. This perspective must replace the much narrower view of relating particular transit operations and services to their profitability or losses incurred in the transit system's accounts of revenue earnings and expenditures (or simply to its 'deficits')."

A large scale improvement of transit services, including the preparation of transit standards, was to be undertaken.

In 1974, the Transportation Plan Part I was approved by City Council. Following the Position Paper and the General Plan, a strong role was given to public transportation. The broad policies and concepts of the Transportation Plan were aimed to "provide a 'balanced' system where a basic road system is complemented by a full public transit system which will accommodate the long term increase in transportation demand" (City of Edmonton, 1974, p.14). That is, public transit was expected to carry a substantially increased proportion of the trips made throughout the city. Other public transportation goals were to provide for public transit facilities in the planning of new communities, to put a major emphasis on rapid transit in future development, to have basic operating standards for the entire city, and "to provide an attractive, efficient and sophisticated public transit service for the majority of Edmonton residents that will provide ready access to the major trip generators and that will provide a viable and competitive alternative to the otherwise automobile oriented traveller" (City of Edmonton, 1974, p.15).

Under the plan, the public transit system was to be organized on a 'transit centre' concept. 'Feeder' routes were to provide local neighbourhood service out of transit centres located at shopping centres and major attraction areas. 'Mainline' routes, express routes and cross city routes were then to provide very frequent service from the transit centres to the downtown and major attractions. Transit service was to be provided to the city centre, the University of Alberta, shopping centres, schools, colleges, libraries, museums, hospitals, government offices, senior citizen homes, multi-family dwellings, and park and recreational areas.

Operating standards were set down as follows (City of Edmonton, 1974, p.57):

> "An area shall be considered to be adequately served by public transit when:
>
> 1. a) the walking distance from most dwellings to the nearest transit boarding point shall not be more than 1300 feet;
>   b) the frequency of base service is not less than one vehicle in each 30 minutes;
>   c) the base service is available from 6:30 a.m. to 11:00 p.m. Monday to Saturday and 9:00 a.m. to 11:00 p.m. on Sundays and holidays;
>   d) passengers are able to board the first vehicle to arrive on any service having an interval between buses of 5 minutes or more, or the second vehicle when the interval is less than 5 minutes;
>   e) time from boarding the first vehicle to downtown shall not be more than 45 minutes.
>
> 2. Minimum service will be provided as defined above for all developed residential areas within the City Boundary or an alternative in the form of "on-demand" services may be provided in selected areas. The hours of operation of such service is to be as in 1(c).
>
> 3. Services beyond the City Boundary will be provided by agreement between the municipalities concerned and the City of Edmonton subject to protection from competition similar to that enjoyed within the City Boundaries.

4. The introduction and staging of industrial services will be on demand, according to routes and times previously agreed to by the Transit System. Services to industrial areas will be provided so that convenient connections may be made to all parts of the Transit System.

5. The service provided by rapid transit shall be superior to the bus service it may replace.

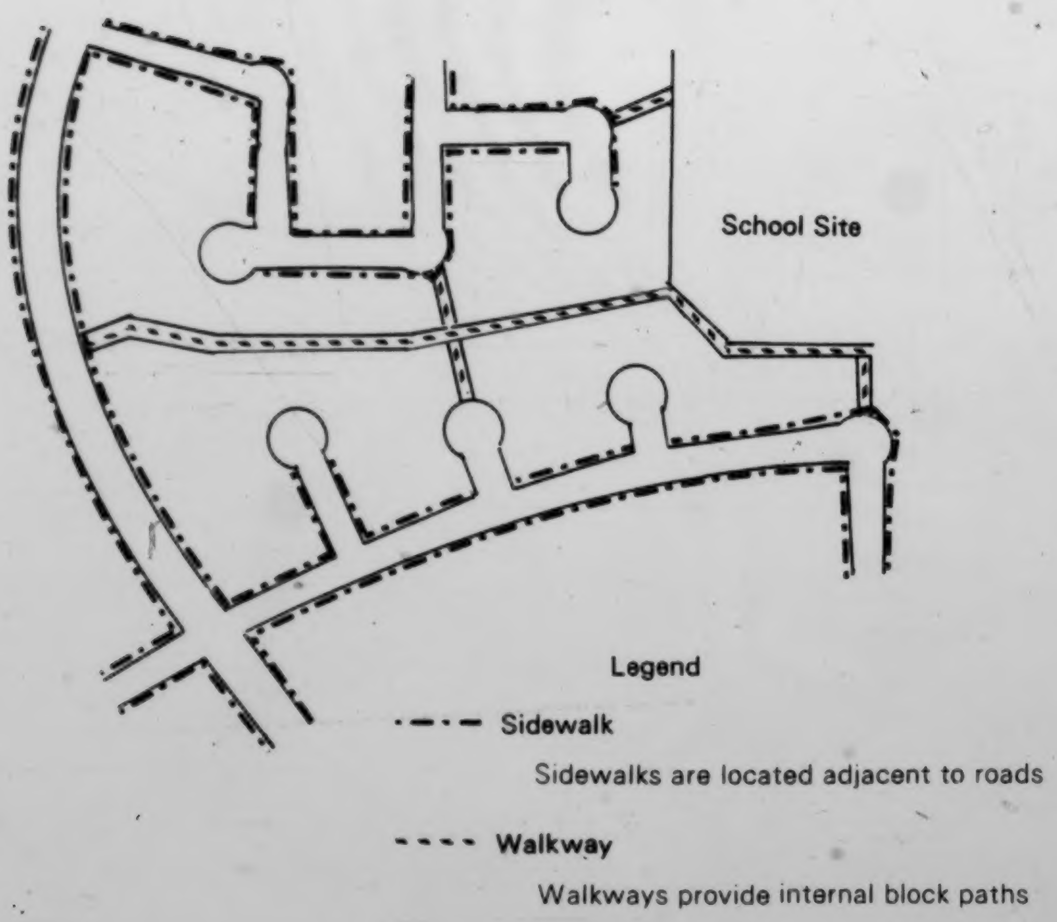
6. Facilities shall be provided where practical for the accommodation of handicapped persons and for the handling of luggage, parcels, baby carriages, etc. during off-peak periods (eg. tip-up seats).

7. Transit vehicles shall be given priority on the public roads."

The Transportation Plan Part I echoed the General Plan in emphasizing the need for a safe, direct and pleasant walking environment, a concern that was closely linked to the emphasis in transit service. In the suburbs, sidewalks, walkways, overpasses and recreation trails were to provide access to schools, public transit, commercial sites, and park and recreational facilities. Sidewalks were to be located adjacent to roads, while walkways were to provide paths within the residential blocks (Figure 10). The specific sidewalk and walkway requirements stated that each residential lot should have direct access to a public walkway or sidewalk, that sidewalks should be placed on both sides of bus routes, and that the neighbourhood pedestrian circulation system should be integrated and comprehensive. However, sidewalks were not required on keyhole crescents having a length of 250 feet (76 m) or less, and were required on only one side of keyhole crescents having a length of 251 to 400 feet (77 to 121 m) (Municipal Planning Commission Minutes, January 29, 1976).

FIGURE 10

SIDEWALKS AND WALKWAYS


School Site
Legend
Sidewalk
Sidewalks are located adjacent to roads
Walkway
Walkways provide internal block paths

The walkway policy was amended on January 27, 1977 with the intent of building fewer but more practical walkways and depending more fully on the sidewalk system for pedestrian circulation. Major walkways were to provide safe, logical routes to major activity nodes including, once again, schools, parks, public transit and commercial facilities. Minor walkways were to provide access points where subdivision design had precluded logical movement. The conventional sidewalk system was not to be duplicated by walkways and mid-block road crossings were to be avoided.

The Transportation Plan Part I also stated that most dwelling units were to be within 1300 feet (400 m) walking distance of bus service; careful placement of bus stops and walkways and/or sidewalks to the bus stops would therefore be required. Residential subdivisions were to be laneless unless this was undesirable for economic or other reasons. Lanes were usually provided along bus routes in order to reduce access points onto the collector roadway. Most important, new residential areas were to be designed with the pedestrian and public transit user in mind.

These planning principles accord closely with many of CMHC's guidelines for accommodating public transit in residential areas. In both cases it was recommended that bus routes follow collector roadways and that public transit be provided for in the plans for new residential areas. Edmonton's departures from the CMHC's principles were all matters of degree rather than of kind. Thus, whereas CMHC recommended that neighbourhood facilities be concentrated at nodes where bus stops could be placed, Edmonton policy required only that the facilities be located in the centre of a neighbourhood. Edmonton's walking distance standards were similarly less stringent, requiring a 'majority' of residents to be within one quarter mile of a stop. Edmonton's policy called for sidewalks on both sides of bus routes but did not stipulate that street design reduce walking distances to public transit services. At the same time, it was recognized that patronage of public transportation depends upon levels of service and the morphology of the entire city, not just the residential areas.

PUBLIC TRANSPORTATION, ACTIVITY SYSTEMS AND RESIDENTIAL DESIGN

Public transportation has not been a central theme in the residential design literature. In practice, British planners have been more likely to include public transportation in their designs than have North American planners who generally are planning low density suburbs. The CMHC guidelines are an indication that this attitude is changing, and that there is greater acceptance of the need to accommodate public transportation, particularly bus service, in the design of suburban communities. The guidelines emphasize that adequate rights of way for buses, good pedestrian access to boarding points, and concentration of activities along the bus routes should be considered during the planning stages of residential developments. In this way capability and coupling constraints on the use of the service can be minimized, and the opportunity for providing high quality public transit service will exist.

In Edmonton, the evolution from neighbourhood planning to the larger scale of suburban districts was accompanied by an increased concern for the accommodation of public transportation. In general, public transportation was not well accommodated in neighbourhood unit plans. The lack of continuous roads within the neighbourhoods forced public transit to use the bounding arterials, and although these were spaced so that maximum walking distances were just over 1300 feet (400 m), public transit users had to cross the busy arterials to reach the service. The designs of some neighbourhood units, for example Parkallen and Belgravia, allowed buses to turn around and retrace their routes. This, however, is useful only at the end of a route.

With the change to larger scale planning in Edmonton, it was recognized that people's daily activities reach beyond their immediate neighbourhoods and that convenient access to a larger urban area is necessary. The district outline plans therefore provided for the public transit system. It was also realized that the freeways required for universal travel by private automobile were prohibitively expensive, and that a segment of the population either could not afford or was unable to use private transportation. The role of public transportation thus grew from a minor auxiliary service in the METS plan to a major form of access in the Transportation Plan Part I.

To this point in the thesis, two main constraints facing public transit users have been emphasized. First, potential users must have physical access to public transit in order for capability constraints to be overcome. Second, coupling constraints require that public transit services must travel to desired destinations and that scheduling of the services must complement the scheduling of activities. The necessary physical access was included in the policies of the General Plan and the Transportation Plan Part I. Residents were to have safe, convenient walking access of 1300 feet (400 m) or less to bus service and public transit was to be provided throughout the city. Population was to be concentrated near transit corridors and future rapid transit stations, and priority service was to be available to schools, community centres, high density developments, commercial centres and churches. As well, where practicable, facilities were to be provided during off-peak hours for handicapped people and for the handling of baby carriages, parcels and luggage.

The public transit service standards in the Transportation Plan Part I addressed some of the coupling constraints. Excess travel time is minimized with the walking distance standard, the provision of service to multi-family housing complexes, and service frequency standards. In-vehicle travel times are regulated to the CBD but not to other locations. Although no specific mention was made of harmonizing public transit and activity schedules, minimum service was to be provided to all residential areas for 16 1/2 hours on weekdays and 14 hours on Sundays and holidays. This should insure that access to activities will be offered during the available 'windows' of time of most residents. Hence, the implementation of Edmonton's planning policies and service standards should minimize many of the coupling constraints and capability constraints facing residents choosing public transit. At the same time it should encourage the residents to perceive a high quality, readily available service.

CHAPTER 5

FORMULATION OF THE PLANS FOR CASTLE DOWNS AND THE BATURYN NEIGHBOURHOOD

CASTLE DOWNS OUTLINE PLANS

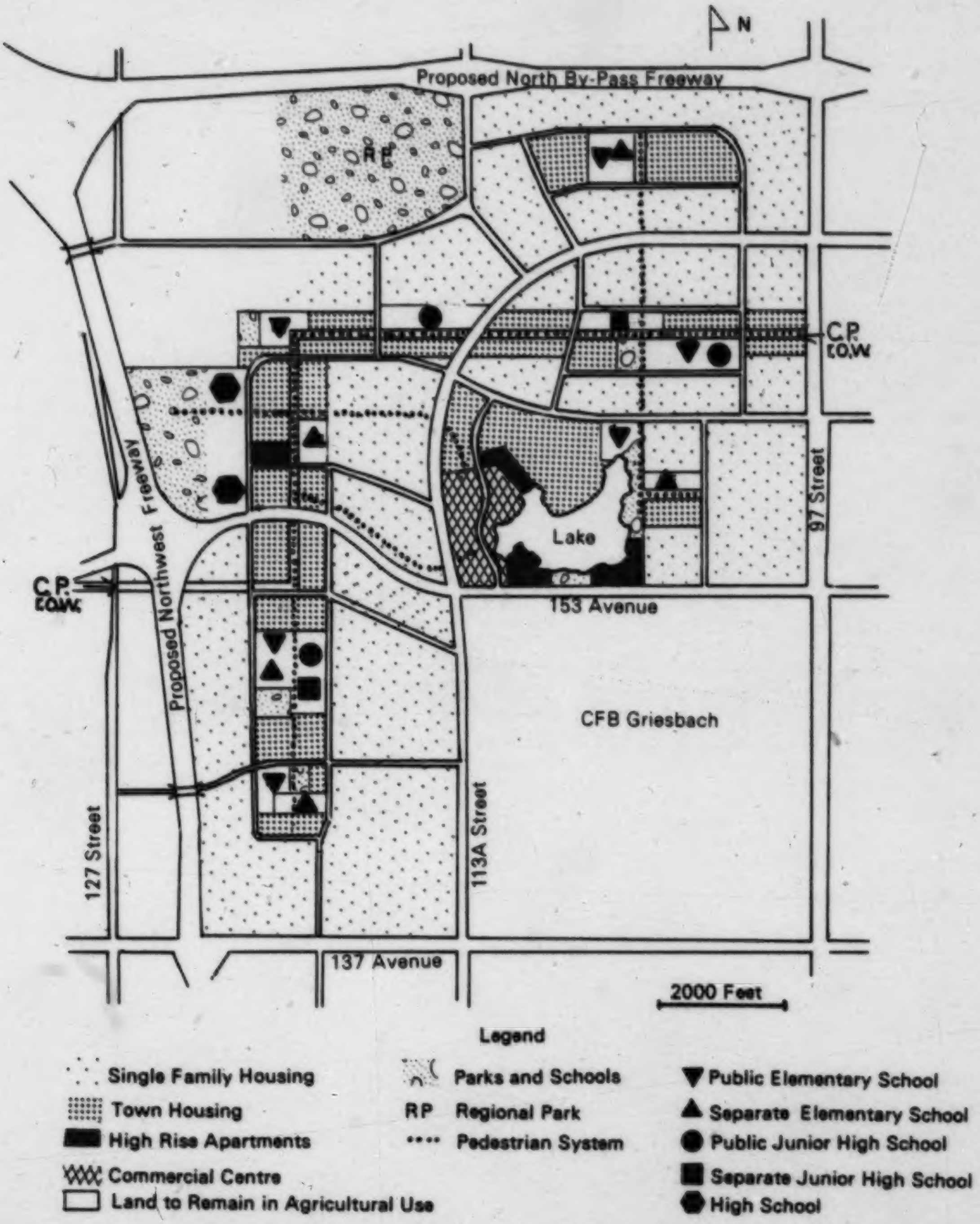
In 1969, a land development company, B.A.C.M., submitted a proposal for the development of a new community to the north of the Edmonton city boundary. Approval in principle was granted by City Council on October 23, 1969, and the lands were annexed in 1970. Then in October 1970, B.A.C.M. submitted the North Edmonton Outline Plan as prepared by the consulting firm, Reid, Crowther and Partners, Ltd., for part of the annexed area. A period of negotiations with the City followed, and an amended plan was submitted by the consultants in October, 1971. The changes included a new name, Castle Downs; the relocation of the sites for the district campus and district park; new land use and population computations; and an additional map detailing bus routes. The Castle Downs Outline Plan received conditional approval by City Council on November 26, 1971. In June, 1973, a consolidated version of the plan was published.

The Outline Plan Area

The outline plans covered three and one-half sections of land between 97 Street (Highway 28) and 127 Street, north of 137 Avenue (Figure 11). Two proposed bypass freeways formed the west and north boundaries. Existing land uses which affected the plans were a

FIGURE 11

NORTH EDMONTON OUTLINE PLAN


N
Proposed North By-Pass Freeway
RP
C.P. r.o.w.
C.P. r.o.w.
Proposed Northwest Freeway
Lake
153 Avenue
97 Street
CFB Griesbach
127 Street
113A Street
137 Avenue
2000 Feet
Legend
Single Family Housing
Town Housing
High Rise Apartments
Commercial Centre
Land to Remain in Agricultural Use
Parks and Schools
RP Regional Park
Pedestrian System
Public Elementary School
Separate Elementary School
Public Junior High School
Separate Junior High School
High School

Source: Modified from Reid, Crowther and Partners Limited (1970) Map 14

Calgary Power right-of-way running through the site, the flight path for the Namao Airport, and the adjacent Griesbach Barracks of the Department of National Defense.

The Residential Areas

The North Edmonton Outline Plan was designed for a target population of 40,000. A strict neighbourhood-community-town centre hierarchy was not adopted, but six neighbourhoods were proposed, four of which were located along a lineal core of schools and parks (Figure 11). This core zone followed the Calgary Power right-of-way but extended further south. It was proposed that the right-of-way and lands flanking it should be used for a succession of elementary and junior high schools, parks, and multiple family dwelling sites (both walk-up and high rise apartments), all joined by a major footpath system. Neighbourhood commercial facilities and churches, which were expected to serve as day-care centres on weekdays, were also to be located along the core. This meant that multiple family dwellings would have easy access to community facilities, to parks, to bus service, to the major walkways and to the collector roads. Single family dwellings were situated beyond the core zone, separated from multiple family dwellings by collector roads. All dwellings were to be within 1300 feet (400 m) walking distance of public transportation.

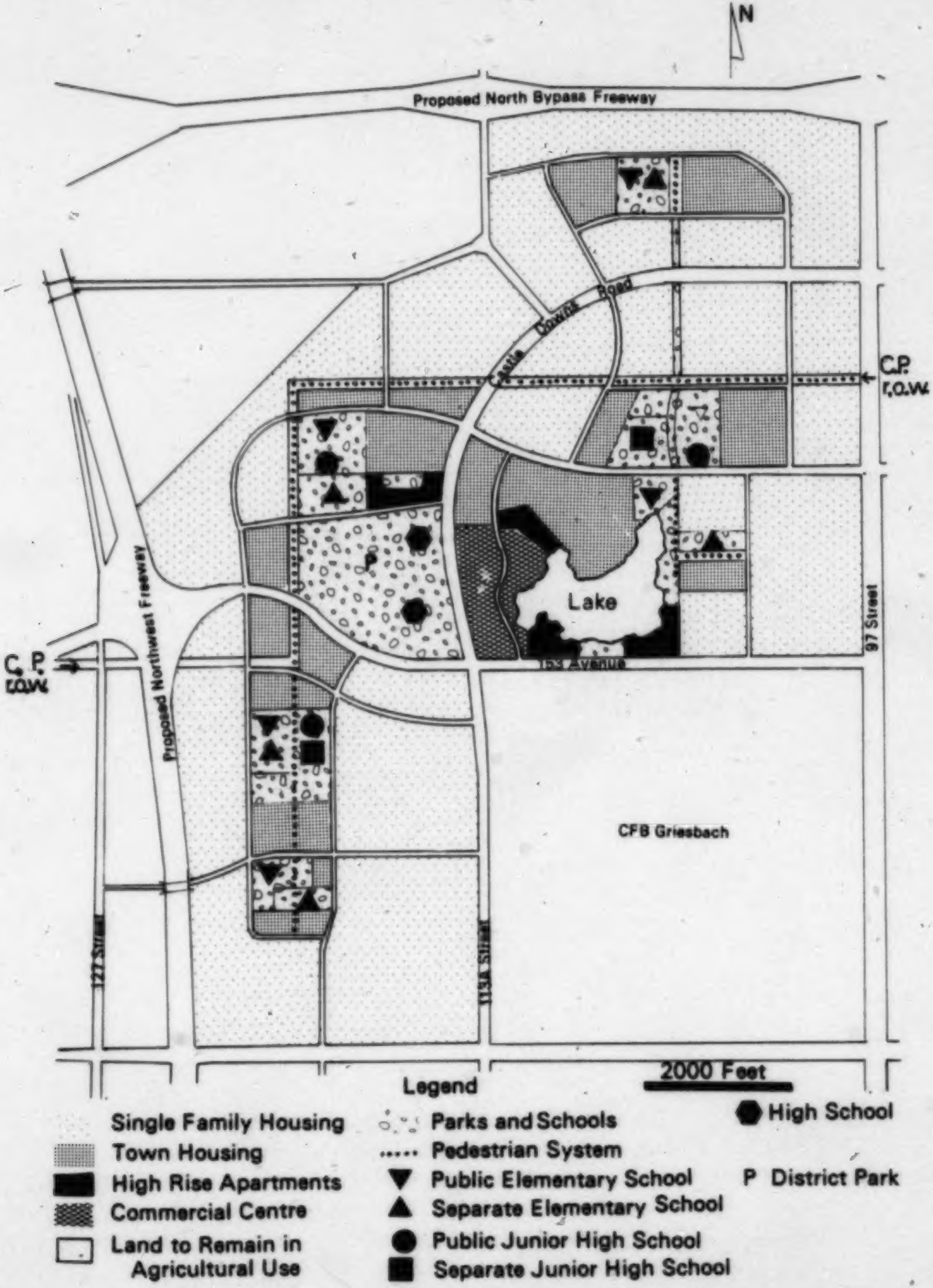
The six proposed neighbourhoods were bounded by arterial and collector roads, but they were not obviously grouped into communities. Only for junior high schools was there some sense of a catchment area larger than the neighbourhood but smaller than the entire plan area.

The lineal core concept drew criticism from the City Planning Department which stated, in a report to the Municipal Planning Commission (March 18, 1971), that the power line right-of-way did not have a 'functional relationship' with the plan area and should not be allowed to dominate the plan. The Department wanted greater emphasis to be placed on the 'dynamic generators of urban form'; that is, the transportation system, functional relationships and topography. The lineal concept made it difficult to provide public transportation to higher intensity uses and created an inconsistent road system. In addition, the Parks and Recreation Department and the Public School Board considered the use of the right-of-way for parks and school lands to be unacceptable (Municipal Planning Commission Minutes, June 17, 1971). The Central Mortgage and Housing Corporation, too, was unsatisfied with the lineal core concept, and argued that if utility lines were located in the right-of-way the land would be less suitable as a walkway. CMHC also questioned placing multiple family housing adjacent to the right-of-way. If, as the plan suggested, the land was unsuitable for single family housing, it was illogical to place an even larger number of people next to this 'unattractive' element.

The Planning Department recommended that the right-of-way be used to establish neighbourhood boundaries and this became a condition of Municipal Planning Commission approval. The Planning Department also objected to the idea of high-rise apartments in a suburban setting, though no action was taken on this. In the revised outline plan, the strong lineal core was modified although the neighbourhoods were still bisected by the Calgary Power right-of-way (Figure 12). The right-of-

FIGURE 12

AMENDED CASTLE DOWNS OUTLINE PLAN


N
Proposed North Bypass Freeway
Castle Downs Road
C.P.
r.o.w.
Lake
P
97 Street
153 Avenue
C.P.
r.o.w.
Proposed Northwest Freeway
CFB Griesbach
127 Street
113A Street
2000 Feet
Legend
Single Family Housing
Town Housing
High Rise Apartments
Commercial Centre
Land to Remain in Agricultural Use
Parks and Schools
Pedestrian System
Public Elementary School
Separate Elementary School
Public Junior High School
Separate Junior High School
High School
P District Park

Source: Modified from Reid, Crowther and Partners Ltd. (June 1973) Map 14a way was flanked by a mix of single and multiple family housing, but nowhere was it incorporated into neighbourhood parks, multiple family projects or school property. The major walkway remained along the right-of-way.

The Town Centre

A community or town centre in approximately the geographic centre of the plan and adjacent to a proposed artificial lake was recommended to provide a 'sense of community', a 'gathering place' and a 'focal point' for the plan area. However, it was also argued that a market survey would be required at the time of construction to determine if a regional shopping centre would be feasible or if it would just serve Castle Downs. Whatever the scale, it was expected that the town centre would contain commercial, social and institutional facilities. The adjacent lake would offer recreation opportunities. Automobile access to all four sides of the centre was proposed, and easy bus and pedestrian access was said to be of 'paramount importance'. High density housing, in a mix of town houses and high-rise apartments, was to be located adjacent to the town centre.

These proposals for the town centre complex were unchanged in the revised outline plan.

The District Campus

In the North Edmonton Outline Plan the district campus was located on the western edge of the outline plan area. The campus, which contained a district park, a separate high school and a public high school, was separated from the town centre by Neighbourhood 3 (Figure 11). The choice of location appears to have been based on the existing tree cover which was thought to be desirable for the district park.

The initial reaction of the Separate School Board was favourable (Separate School Board Correspondence, January 27, 1971). However, when Edmonton Transit expressed concern about the difficulty of providing adequate, economical bus service to the site, both school boards declared doubts of their own. The Public School Board, in particular, suggested that the public transit routes should be determined before it could make final comments (Public School Board Correspondence, March 16, 1971).

Edmonton Transit studied three possible sites for the campus: the west site as proposed in the outline plan; a central site immediately west of the town centre; and a site just south of the town centre. The following principle was put forward (Edmonton Transit Correspondence, May 27, 1971):

> "The location of the high school campus should attempt to maximize the number of students in a position to walk to the site and minimize the volume of students required to utilize public transit."

Because the south and the central sites were within walking distance of the high density housing near the lake, fewer students would need to be bussed to school. As well, regular routes that focused on the town centre could better serve these sites. Additional school bus service would have been required for all sites but the cost of servicing the western site was estimated to be $70,000 to $85,000 more per year (1971 dollars) than for the central site. In correspondence with the City Planning Department (May 27, 1971), Edmonton Transit added that service by regular transit routes was preferable because "the extra buses could not be available at other than a set starting and finishing time each day, substantially restricting the use of school facilities at other periods". The Public School Board agreed, both because of cost and because of "the trend towards the semester system in which many pupils are required to travel in periods of the day when school buses are not available". Increased community use of school facilities was also mentioned (Municipal Planning Commission Minutes, June 17, 1971).

As a result of these various objections, the Municipal Planning Commission required that the high school campus be relocated (Municipal Planning Commission Minutes, June 17, 1971). The central location was chosen, and the campus was located west of the town centre but separated from it by 113A Street, an arterial road (Figure 12).

Transportation

When the North Edmonton and Castle Downs outline plans were submitted in 1970 and 1971, the Metropolitan Edmonton Transportation Study was still the planning guide for transportation facilities. A major residential development in the area of Castle Downs had not been anticipated in METS, but the plans nonetheless called for the early construction of the northwest freeway to facilitate travel from Castle Downs to other parts of the city. It was not until 1975 that City Council abandoned the northwest freeway as a planning concept.

The outline plans proposed a hierarchical road system to accommodate the internal traffic circulation. Two major arterials were proposed, 153 Avenue traversing the area from east to west and 113A Street running from 137 Avenue but curving near the northern boundary of Castle Downs to meet 97 Street. The town centre and the eventual site of the district campus were located at the intersection of the two arterials. It was also intended that collector roads should be spaced so that no vehicle need travel more than 1000 feet (330 m) on a local road before reaching a collector road.

In a report compiled by the Planning Department for the Municipal Planning Commission, the functional hierarchy of the internal road system was described as hard to discern. It was suggested that roads had been determined by "existing allowances and jurisdictional boundaries which had little relationship with the ideal structure of the neighbourhood they are intended to serve" (Municipal Planning Commission Minutes, March 18, 1971). It was also stated that no local roads should have direct access to 97 Street and that the collector road in the western portion of Neighbourhood 5 should connect with the collector road in Neighbourhood 6 to provide continuity for bus routes (Engineering Department Correspondence, March 3, 1971).

Initial revisions to the road system were made in May 1970 and further changes followed when the district campus was relocated. The resulting road system, which had greater internal continuity and fewer connections to 97 Streeet, formed the basis for more detailed neighbourhood planning (Figure 12).

Public Transportation

In the North Edmonton Outline Plan it was claimed that the collector road system allowed many alternative public transit routes which would provide service within one-quarter mile of all housing areas. The high density lineal core could be easily served and the need for public transit service to the town centre and for multiple family dwellings was mentioned. However, the plan cautioned that patronage would be low because trip times to the CBD could be greater than one hour - that is, 40 minutes in-vehicle time plus walk and wait times. A rapid transit route to either west or east of the outline plan area was a suggested solution, but the town centre was thought to be in an unfavourable location for a station. It was therefore proposed that a feeder bus system would also be required.

For its part, Edmonton Transit was unhappy with these proposals and argued that public transportation had been an afterthought, once the land use and roadway patterns had been determined. The result, it was claimed, was a road system that would impose circuitous and cumbersome transit routes with little regard for actual travel patterns (Edmonton Transit Correspondence, March 3, 1971).

Edmonton Transit and the consultants then had a series of meetings to discuss the provision of bus service. The consultants stated that bus routes were omitted from the plan so as not to commit Edmonton Transit to any service that might become undesirable in the future. Also, they argued, the plan was sufficiently flexible to allow an acceptable standard of public transportation. Edmonton Transit argued that routes should be shown so that the City would be aware of its obligations. If routes, stop locations, and the relation to high density housing and walkways were not determined at the outline plan stage, planning would advance to the point that it was too late to make changes. Reid, Crowther and Partners, Ltd. remained unconvinced, saying that outline plans were conceptual only and that routes and bus stop locations were more appropriately determined at the detailed planning stage (Edmonton Transit Minutes, February 12, 1971).

As a result of the discussion, Edmonton Transit prepared a list of public transportation planning criteria (Edmonton Transit Correspondence, February 19, 1971). The ideal public transit would offer maximum route coverage with minimum walking distance, but it was also necessary to balance cost and service. Bus routes it was said, should be as straight as possible because excessive turning reduces speed while increasing delay factors and accident potential. The result is to escalate operating costs. In addition, Edmonton Transit stated (Edmonton Transit Correspondence, February 19, 1972):

> "As the transit mode is an extension of the pedestrian mode, planning should consider the passage the pedestrian is going to follow from his residence to a bus stop and the walkways should be geared for the maximum convenience to transit patrons. The walking distance is a function of the bus stop and not the bus route. Bus stops should be spaced every other block or approximately 1,000 feet apart with about 90% of the population located within 1,300 feet of a bus stop. The high density and medium density housing should be as close as possible or adjoining the bus stops with low density housing predominating the land use as walking distance from a bus stop increases."

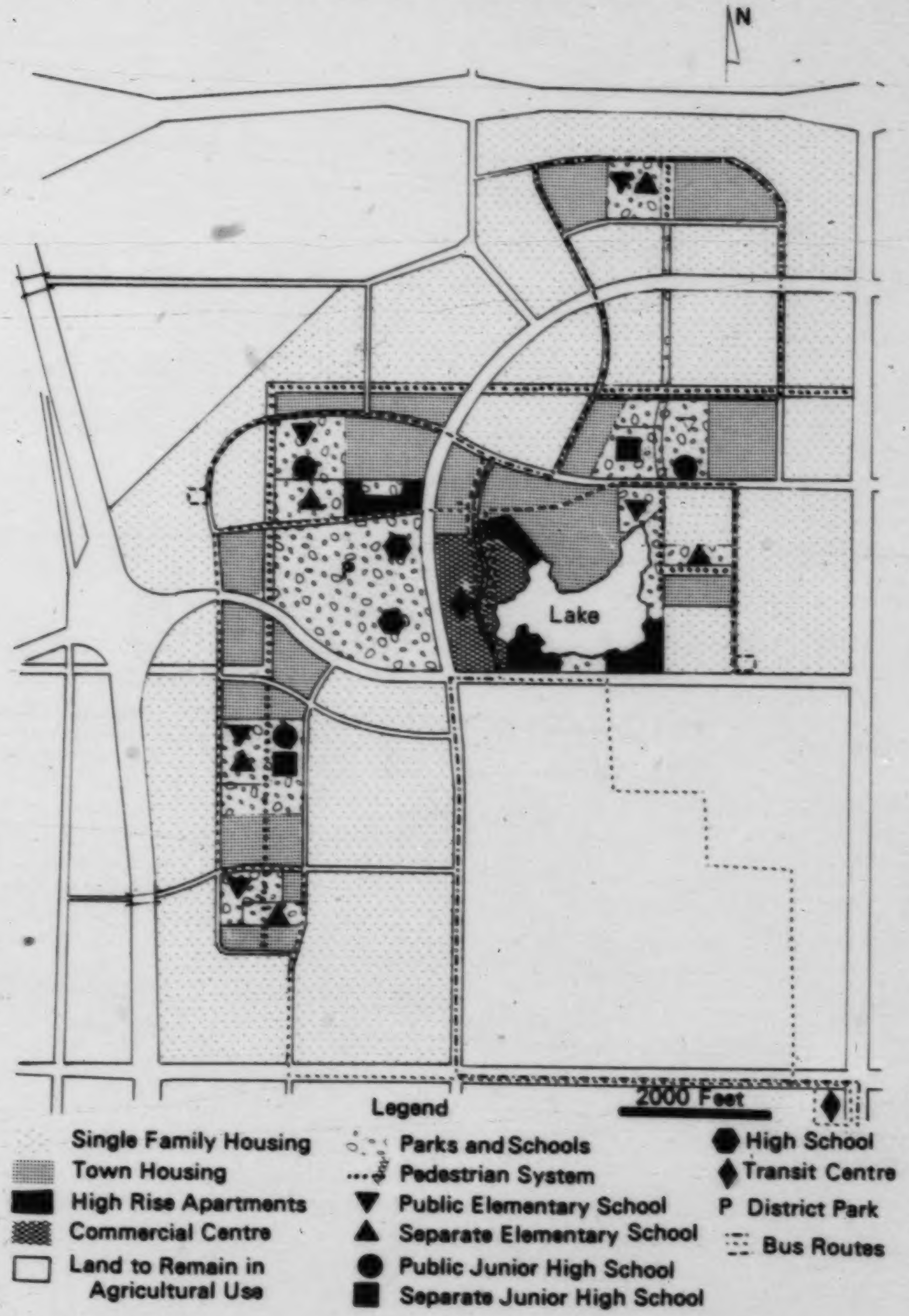
Specifically, it was recommended that high rise apartments should be within 750 feet (250 m) of a bus stop. Other criteria included the following: pavement width of roads to be used as bus routes should be a minimum of 38 feet wide to allow efficient, safe operation of vehicles; land uses should be arranged so that major traffic generators should be in a straight line with high density housing; junior and senior high schools should be located to permit the maximum number of students to walk to school, although senior high schools also require convenient public transit access from all parts of the catchment area; and commercial sites should be located at transit-oriented corners, with parking facilities behind the buildings. This last feature was intended to ensure that patrons would be provided with a short, convenient and sheltered access to the shops from transit vehicles. It was further recommended that rapid transit stations with park-and-ride and kiss-and-ride facilities should act as focal points for the bus routes, and that bus access should be free of conflict with automobiles. In the event that rapid transit would not be extended to the Castle Downs area, Edmonton Transit recommended bus-only lanes on 97 Street in order to reduce CBD travel times and to make public transit an attractive mode of travel.

Edmonton Transit came to the conclusion that with the proposed lineal core concept and the separated locations of the town centre and district campus, there were only two alternatives for bus service in Castle Downs: either a high quality, attractive service which was costly to operate and would therefore result in an operating deficit, or a token service which minimized cost but would still generate a deficit because few riders would be attracted to it (City of Edmonton, 1971c). However, when the campus location was changed, it could be served directly by all three transit routes that were then being considered. A map detailing the proposed transit routes was included in the Revised Outline Plan (Figure 13).

In 1976, after the freeway proposal had been officially abandoned and it was known that development would be allowed under the flight path of the Namao Airport, the Transportation Planning Branch of the City Engineering and Transportation Department produced a public transit plan for Castle Downs (City of Edmonton, 1976). This was based on the operational standards of the Transportation Plan Part I and two concepts were emphasized. First, transfer connections were concentrated on the town centre and, second, extensions of the routes to a possible commercial development on 97 Street and 163 Avenue were allowed for. The proposed transit plan (Figure 14) consisted of four routes with four transfer points. Service to the Northwest Industrial Area, possible extensions to Castle Downs Stage II east of 97 Street, and service to North Town Mall and the CBD were included. This plan

FIGURE 13

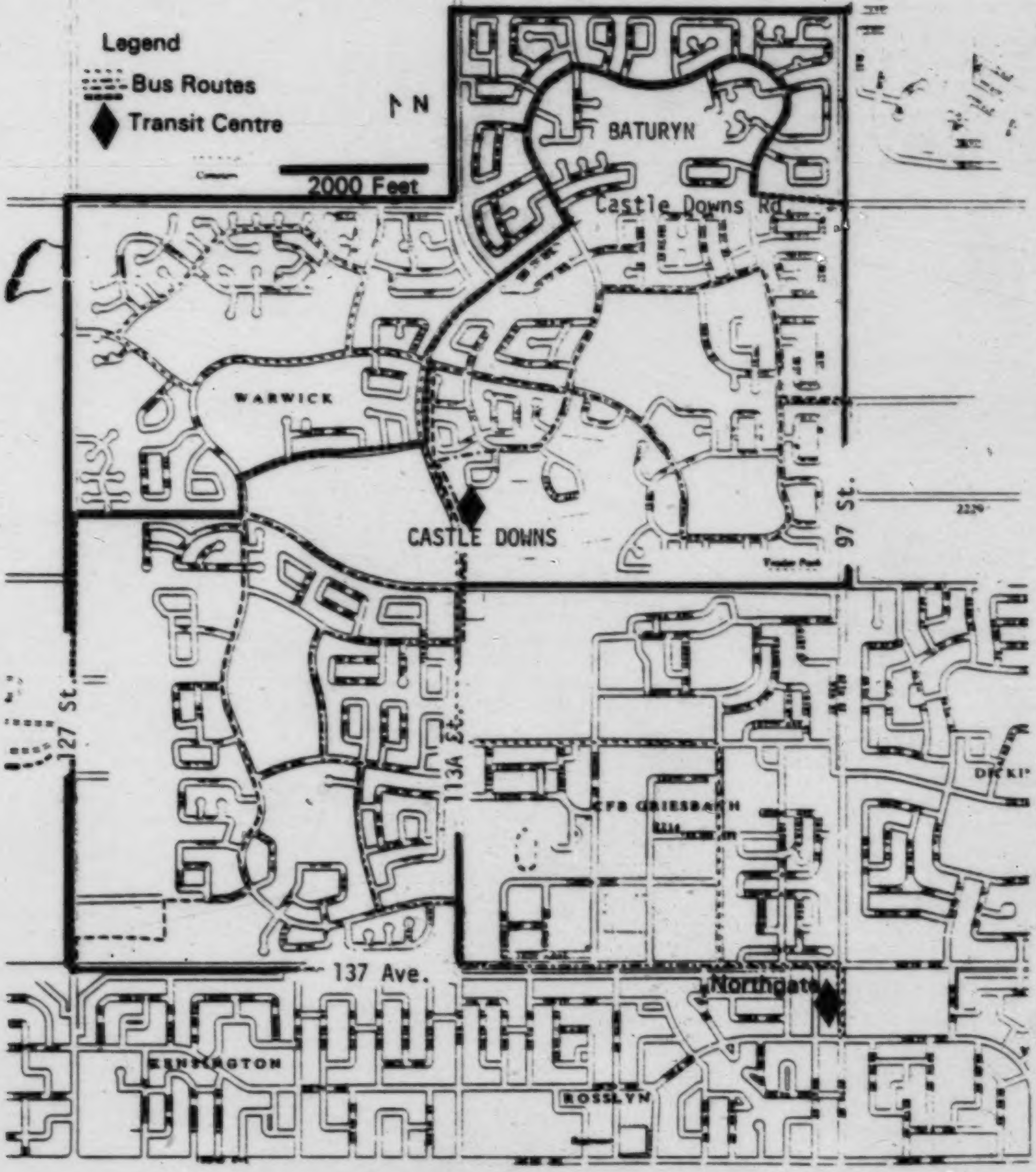
PROPOSED BUS ROUTES


N
Lake
P
2000 Feet
Legend
Single Family Housing
Town Housing
High Rise Apartments
Commercial Centre
Land to Remain in Agricultural Use
Parks and Schools
Pedestrian System
Public Elementary School
Separate Elementary School
Public Junior High School
Separate Junior High School
High School
Transit Centre
P District Park
Bus Routes

Source: Modified from Reid, Crowther and Partners Ltd. (June 1973) Map 24

FIGURE 14

CASTLE DOWNS RECOMMENDED TRANSIT PLAN


Legend
Bus Routes
Transit Centre
N
2000 Feet
BATURYN
Castle Downs Rd
WARWICK
CASTLE DOWNS
97 St.
127 St.
113A St.
CFB GRIESBACH
137 Ave.
Northgate
KENSINGTON
ROSSLYN

Source: Modified from City of Edmonton, Transportation Planning Branch (April 1976) "Castle Downs Public Transit Plan" was used as the basis of transit planning in Castle Downs until 1981, when a new plan was developed which more closely followed Edmonton Transit's 1971 recommendations.

The Consideration of Capability Constraints in the Outline Plans

The original North Edmonton Outline Plan, in compliance with the requirements of Edmonton's General Plan, presented a comprehensive land use and transportation plan for the Castle Downs area. This was similar in many respects to the Don Mills 'prototype'. The neighbourhood was the basic unit of development, green spaces, parkland and walkways were important elements of the plan, and a hierarchical road system was used. Unlike Don Mills, but like Mill Woods, no major employment component was included. Carver's concept of 'a city in the suburbs' was reflected in the proposals for a town centre as the focus of the new community. Unlike Mill Woods, but like Don Mills, Castle Downs did not include an intermediate 'community' level in the facility framework, perhaps because Castle Downs was to have less than half the ultimate population of Mill Woods.

Because the transportation chapter of the General Plan had not yet been adopted, METS remained the official transportation planning document at the time the North Edmonton Outline Plan was drafted. Perhaps for this reason, public transportation was not well integrated with land use. As well, it was envisaged that the predicted long trip time to the CBD for public transit users would discourage possible patrons, and rapid transit to the north-central area of Edmonton had not been seriously considered. Although the outline plan gave assurance that all dwellings would be within one-quarter mile of bus service, it was debatable whether the plan had been formulated with transit in mind: the district campus was separated from the town centre, the collector road system lacked continuity, and the Calgary Power right-of-way dominated the layout of neighbourhoods.

It also follows that the North Edmonton Outline Plan did not focus on the activity systems of the future residents. The little attention that was paid to the daily patterns came by incorporating the neighbourhood-town centre framework for the provision of community services and facilities. However, the ensuing debate over the location of the district campus was a clear consideration of activity systems. Chapin hypothesized that planners, through their priming location decisions, could affect people's secondary decisions. In the case of Castle Downs, the district campus was moved so that future students and other residents would have a greater propensity to use public transit or to walk to the facilities. It was expected that service to the new location would be more economical and, because more direct service would be available to the campus, that ridership would be higher. Put another way, when the location of the campus was changed so that service by regular public transit was maximized, the coupling constraints for residents wishing to use public transit were lessened. As well, concentrating the campus and town centre facilities was expected to permit residents to combine more activities into one trip.

The North Edmonton Outline Plan did state that neighbourhood commercial facilities, churches, day-care centres and schools should be located 'conveniently', and that all homes should be within one-quarter mile of public transit service, but this was the extent to which the capability constraints of residents wanting to reach the facilities were considered. The planning criteria formulated by Edmonton Transit went much further in recognizing capability constraints. In particular, the inclusion of transit routes in the revised outline plan was a necessary step towards allowing capability constraints to be considered more fully during detailed planning. Land uses could be arranged to ensure proximity to bus service as desired, and neighbourhoood facilities could be located on bus routes. The local roads and walkways could be designed to insure convenient access to both public transit and community facilities.

OUTLINE PLANS FOR NEIGHBOUROOD 6 - BATURYN

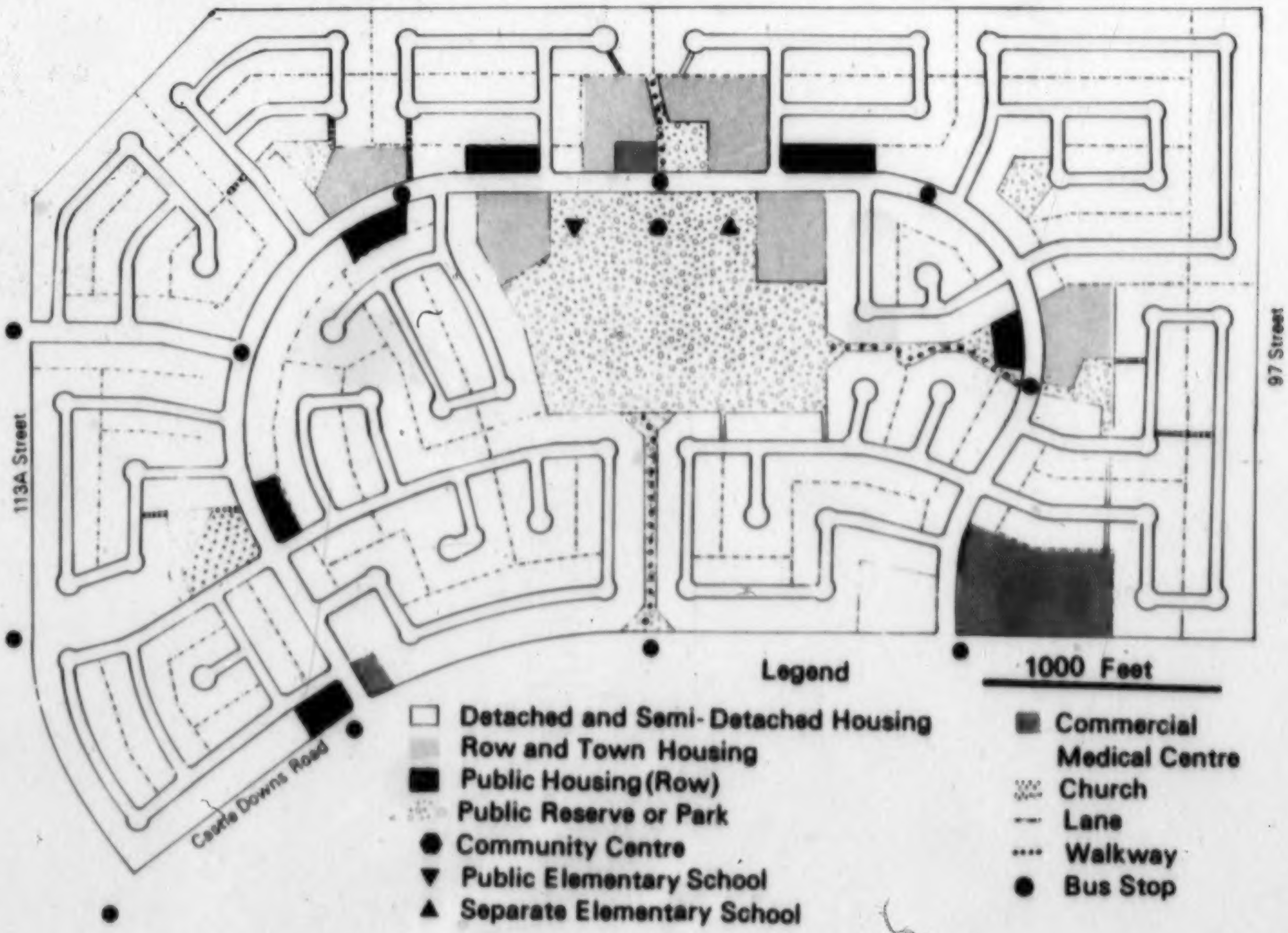
The approved outline plan for the whole of Castle Downs provided guides for the development of the neighbourhood outline plans. Neighbourhood 6, Baturyn, is the most northerly of Castle Downs neighbourhoods. It is bounded by 97 Street to the east, Castle Downs Road to the south, 113A Street to the west and the 1972 city limits to the north. The outline plans for Neighbourhood 6 and Neighbourhood 5 to the immediate south were submitted together on December 21, 1972, but they were reviewed separately. Three revisions of the Neighbourhood 6 outline plan were submitted before Municipal Planning Commission approval was given on November 22, 1973. Then, due to uncertainty about the alignment of the outer ring road (the north bypass freeway), B.A.C.M. allowed approval of the Baturyn outline plan to lapse. In June 1975, yet another revised outline plan was submitted, further changes were made, and on October 9, 1975, Municipal Planning Commission approval was received once again. In all, six versions of the plan had been submitted, but only the four most important ones will be discussed here: the original submission, the first approved plan, the resubmitted plan of June 1975, and the approved plan of October 1975.

The Original Submission - December 20, 1972

The first neighbourhood outline plan for Baturyn closely followed Perry's concept of a neighbourhood unit (Figure 15). A large park, the public and separate elementary schools, a church site and a small site for convenience stores were located in the centre of the neighbourhood. The main commercial site was located in the southeastern corner of the neighbourhood, adjacent to Neighbourhood 5 and on the intersection of the neighbourhood collector road and Castle Downs Road. A medical centre was proposed close by, and another small commercial site and a church site were located in the southwestern part of the neighbourhood, again on the collector street. Five small parks were distributed throughout the neighbourhoood. The road system was intended to discourage through traffic; the collector road looped through the neighbourhood with a short connection to 113A Street, but did not offer an obvious short cut. Most local roads intersected the collector road at 'T' junctions and rear lanes were shown throughout the entire plan area. A major walkway connected Neighbourhood 6 with

FIGURE 15

BATURYN NEIGHBOURHOOD OUTLINE PLAN, DECEMBER 20, 1972


97 Street
113A Street
Castle Downs Road
1000 Feet
Legend
☐ Detached and Semi-Detached Housing
Row and Town Housing
■ Public Housing (Row)
Public Reserve or Park
● Community Centre
▼ Public Elementary School
▲ Separate Elementary School
■ Commercial
Medical Centre
▨ Church
-- Lane
···· Walkway
● Bus Stop

Source: Modified from BACM Development Corporation December 20, 1972

Neighbourhood 5 and the major walkway along the Calgary Power right-of-way. A second major walkway connected the eastern small park with the central park and school site, and numerous minor walkways improved access to parks and commercial sites. Multiple family housing in the form of walk-up apartments and row housing was located along the collector road.

Bus stops were spaced from 800 to 1200 feet apart along the collector road and within 1300 feet walking distance of all but four small peripheral groups of houses. All multiple family housing was within 750 feet of a bus stop. Although access could have been improved with additional minor walkways and some rearrahgement of bus stops, the neighbourhood was well planned from the point of view of public transportation. Access to bus stops was direct and major activities and higher density housing were adjacent to the collector road on which the bus service would run.

Initially, the Transportation Planning Branch of the City Engineering Department, which shared the responsibility for long term transit planning with Edmonton Transit, indicated its general pleasure with the way that public transit was accommodated in the plan (Engineering Department Correspondence, January 25, 1973). Later, however, in a more detailed critique, it was suggested that additional walkways could improve access to facilities and that some walkways shown in the plan were unneccessary and should be removed. It was also requested that automobile access to residential lots fronting onto the bus route be restricted to rear lanes because vehicles backing out of driveways could interfere with bus and other vehicular movements on the collector road. Also, private driveways could affect bus stop location adversely (Engineering Department Correspondence, February 16, 1973). It was the practice to provide straight-faced curbline walks on bus routes to insure pedestrian safety and facilitate snow removal from roads. Curb cuts for front driveways were expensive - approximately $250 each - and it was reported that a "multiplicity of driveway locations (or curb cuts) defeats the purpose of straight face curb construction" (Engineering Department Correspondence, February 16, 1973).

The Transportation Planning Branch prepared plans for bus routes to serve Neighbourhoods 5 and 6 (Engineering Department Correspondence, February 16, 1973). Two routes were proposed, one looping through each neighbourhood. This routing departed from that prepared by Edmonton Transit for the Castle Downs Outline Plan where a single route ran through both neighbourhooods (Figure 13). The Transportation Planning Branch argued that inter-neighbourhood bus travel would be minimal because functions strongly oriented towards transit service, such as a high school campus or retail outlets, were not located in either neighbourhood, while the junior high schools in Neighbourhood 5 were within walking distance of students living in Neighbourhood 6. Also, it was felt that neighbourhood identity would be enhanced by providing each neighbourhood with its own route. The two school boards and the Parks Department, on the other hand, preferred a single route through both neighbourhoods, to give inter-neighbourhood access to the junior high schools (Edmonton Separate School Board Correspondence, January 19, 1973; Engineering Department

Correspondence, February 12, 1973; Utility Planning Meeting Minutes, March 21, 1973). No correspondence from Edmonton Transit commenting on the Transportation Planning Branch proposal was found.

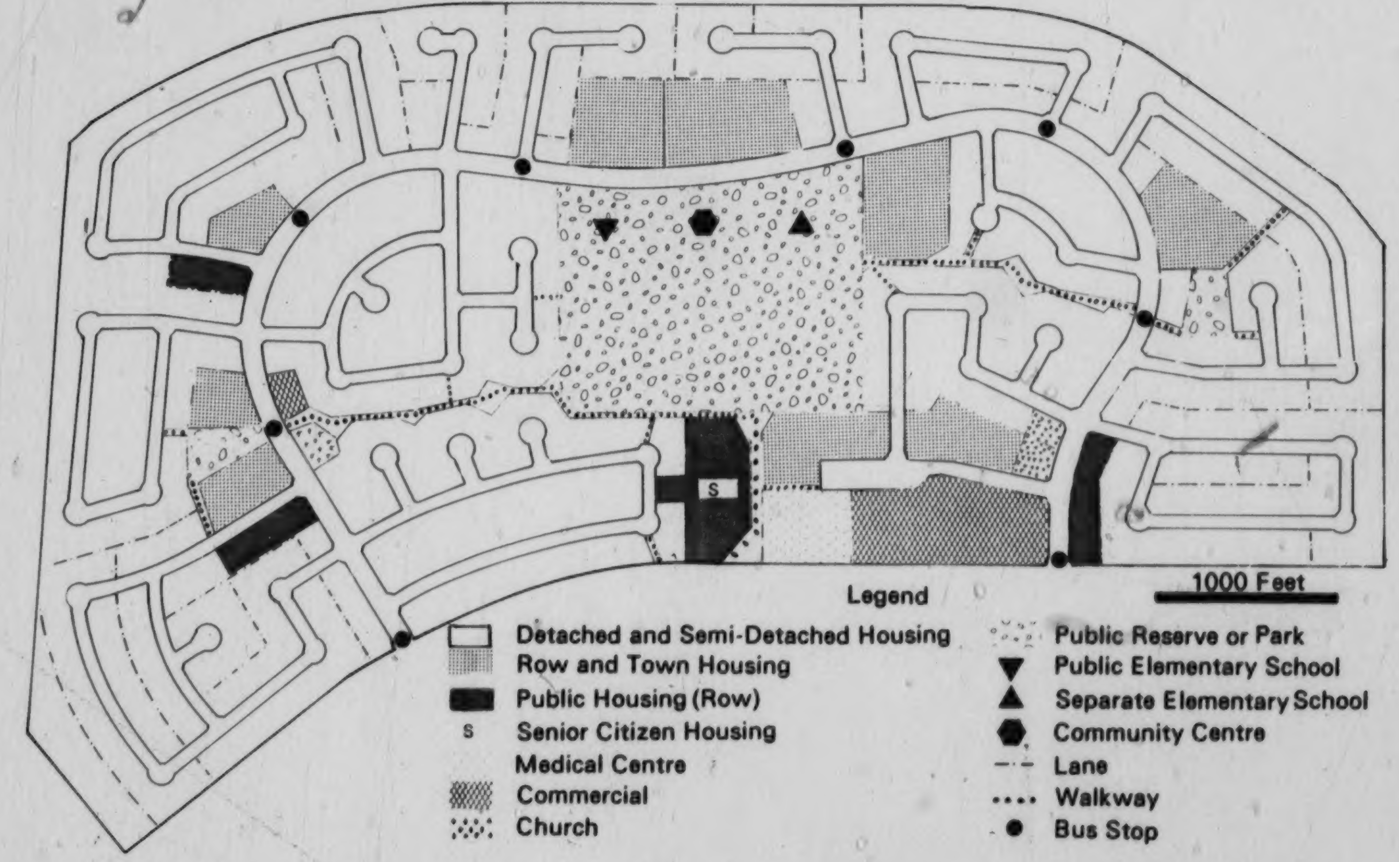
Other criticisms of the neighbourhood outline plan came from the City Planning Department (Planning Department Correspondence, March 8, 1973). The lack of a neighbourhood centre was particularly mentioned and it was suggested that the large commercial and medical sites, which were departures from the Castle Downs Outline Plan, should have been located centrally and in conjunction with the major walkway. This, in turn, led to criticism of the high density housing sites which, it was said, should have been concentrated around the commercial site rather than the large park. The Planning Department also criticized the large number of rear lanes, stating that the General Plan discouraged lane subdivisions. Finally, it was suggested that the number of single family lots fronting onto the collector street should be reduced.

Revision 4 - November 16, 1973

On August 4, 1973, and October 26, 1973, second and third sets of revisions were submitted. They were followed, on November 16, by revision 4 which was to receive Municipal Planning Commission approval. A neighbourhood centre on Castle Downs Road was included (Figure 16). It incorporated the large commercial site and the medical offices. Higher density housing was adjacent to the centre, the park, and the school site. The major walkway connected the centre with Neighbourhood 5, with the park and school site, and with a smaller

FIGURE 16

BATURYN NEIGHBOURHOOD OUTLINE PLAN-REVISION 2, AUGUST 14, 1975


S
1000 Feet
Legend
Detached and Semi-Detached Housing
Row and Town Housing
Public Housing (Row)
S Senior Citizen Housing
Medical Centre
Commercial
Church
Public Reserve or Park
Public Elementary School
Separate Elementary School
Community Centre
Lane
Walkway
Bus Stop

Source: Modified from City of Edmonton, Municipal Planning Commission Minutes, August 14, 1975 complex in the western part of the neighbourhood containing multiple family housing, a church site and a small commercial site. Bus stops were shown on two sides of the neighbourhood centre - on the neighbourhood collector street and on Castle Downs Road. The additional multiple family housing was well located along the collector road/bus route and was, in most cases, adjacent to either the central park or one of the two small parks.

Because the alignment of the proposed outer ring road was not fixed, and because of uncertainty about flight path restrictions in the northwestern corner, the neighbourhood was reduced in size by shifting the northern boundary southwards. As a result, the local road system changed. The connection to 113A Street was removed, requiring a modification of the bus route. Many of the rear lanes were removed as well. Some of them paralleled the bus route, but no correspondence was found requesting that they be reinstated. Bus stops were placed 800 to 1200 feet apart along the neighbourhood collector street. All but one small peripheral single family area was within 1300 feet walking distance of a bus stop, and all but small parts of two multiple family sites were within 750 feet.

On November 22, 1973, this version of the outline plan was supported by the Municipal Planning Commission as the guide to the preparation of detailed subdivision plans. The first two plans, 73-X-123-S and 74-X-026-S, were given conditional Municipal Planning Commission approval on January 31, 1974 and May 30, 1974, respectively. However, due to continuing uncertainty over the ring road alignment, B.A.C.M. submitted a revised neighbourhood outline plan in June, 1975.

Revision 5 - June 10, 1975

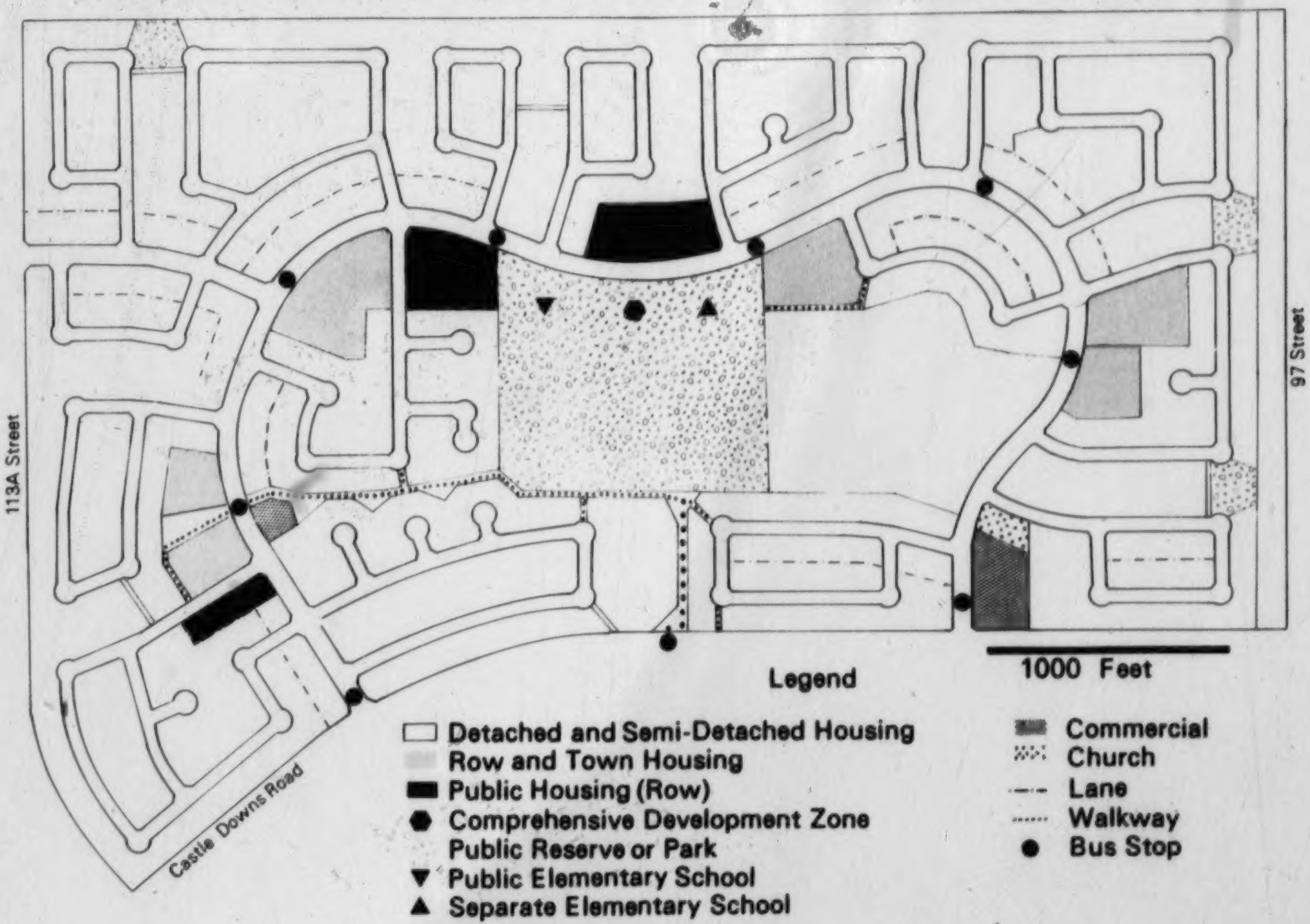
Revision 5 reverted to the development boundaries used in the first neighbourhood outline plan submission (Figure 17). The neighbourhood centre was also removed, largely because a large commercial complex had been built on the south side of Castle Downs Road in Neighbourhood 5 (B.A.C.M. Correspondence, June 10, 1975). The medical centre was relocated to the Castle Downs town centre. A small commercial site adjacent to public housing and a church site were located on the eastern intersection of Castle Downs Road and the collector road. A second small commercial site was located on the collector road in the western part of the neighbourhood. Row housing and public housing were located in proximity to this site.

The proposed senior citizens' housing site was replaced by a 'comprehensive development' zone, a use category that allowed individual development proposals to be approved on their merits. A large comprehensive development zone was also included in the eastern half of the neighbourhood. Multiple family housing was restricted to row housing, reflecting the shift in demand away from walk-up apartments. All multiple family housing was adjacent to the collector road with the exception of one public housing site. Four small parks were shown, three of them located at the outer boundaries of the plan area.

The collector road system was similar to that of the first outline plan submission, except for a greater curve in the east-west portion in an attempt to reduce the potential for motorists to speed. Although the collector road connection to 113A Street was reinstated,

FIGURE 17

BATURYN NEIGHBOURHOOD OUTLINE PLAN- REVISION 5, JUNE 10,1975

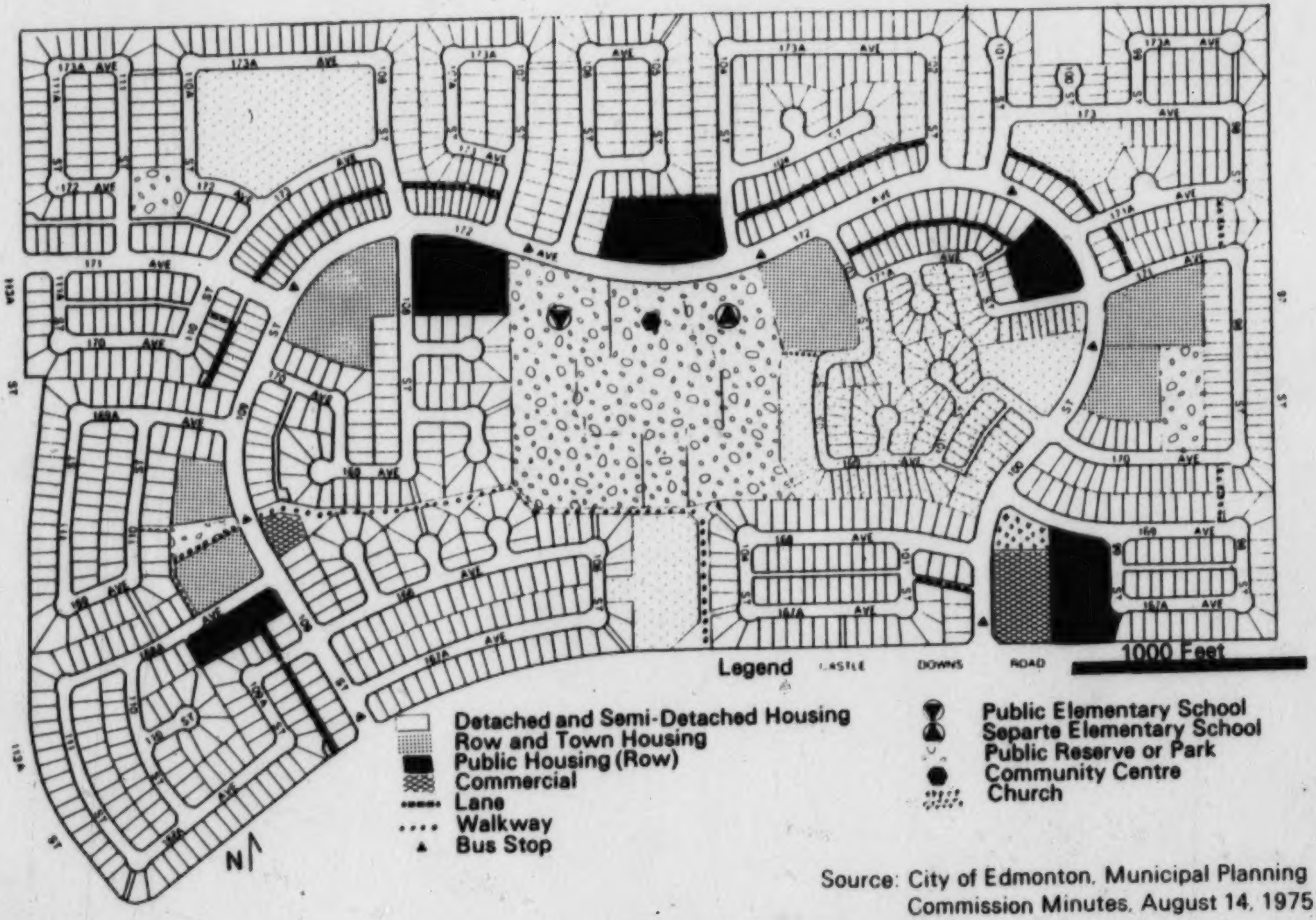

113A Street
97 Street
Castle Downs Road
1000 Feet
Legend
☐ Detached and Semi-Detached Housing
Row and Town Housing
■ Public Housing (Row)
⬢ Comprehensive Development Zone
Public Reserve or Park
▼ Public Elementary School
▲ Separate Elementary School
▨ Commercial
⁘ Church
-·- Lane
····· Walkway
● Bus Stop

Source: Modified from BACM Development Corporation, December June 10, 1975 no bus stops were indicated along it. Rear lanes paralleled most of the bus route and the collector road connection to 113A Street. A major walkway extended from Neighbourhood 5 to the park and school site and the western commercial site. Few minor walkways were included, because it was intended that pedestrian access would be provided along street sidewalks. Bus stops were spaced 900 to 1100 feet apart along the collector road. Large areas of the plan were beyond 1300 feet walking distance of a bus stop and one public housing site was beyond 750 feet of a bus stop. Revised bus stop locations and improved walkway placement could have reduced the walking distances.

On August 14, 1975, the Planning Department requested Municipal Planning Commission approval of the plan, with the conditions that the small parks be more centrally located, minor walkways be more centrally located, minor walkways to Castle Downs Road be realigned to reduce mid-block pedestrian crossings and lanes paralleling the connection to 113A Street be eliminated. The revisions were made and final approval was granted on October 9, 1975 (Figure 18).

Accommodation of Public Transit

The final approved neighbourhood outline plan appears to have been well formulated from a public transportation point of view. Higher density housing and commercial sites were located adjacent to the bus route along the collector road. Walkways, sidewalks and rear lanes provided easy walking distances and perceived direct access to future public transit routes in most cases, although some reduction in


Legend
Detached and Semi-Detached Housing
Row and Town Housing
Public Housing (Row)
Commercial
Lane
Walkway
Bus Stop
Public Elementary School
Separte Elementary School
Public Reserve or Park
Community Centre
Church
CASTLE DOWNS ROAD
1000 Feet
N
172 AVE
173A AVE
170 AVE
169 AVE
167A AVE
113A ST
97 ST

Source: City of Edmonton. Municipal Planning Commission Minutes, August 14, 1975.

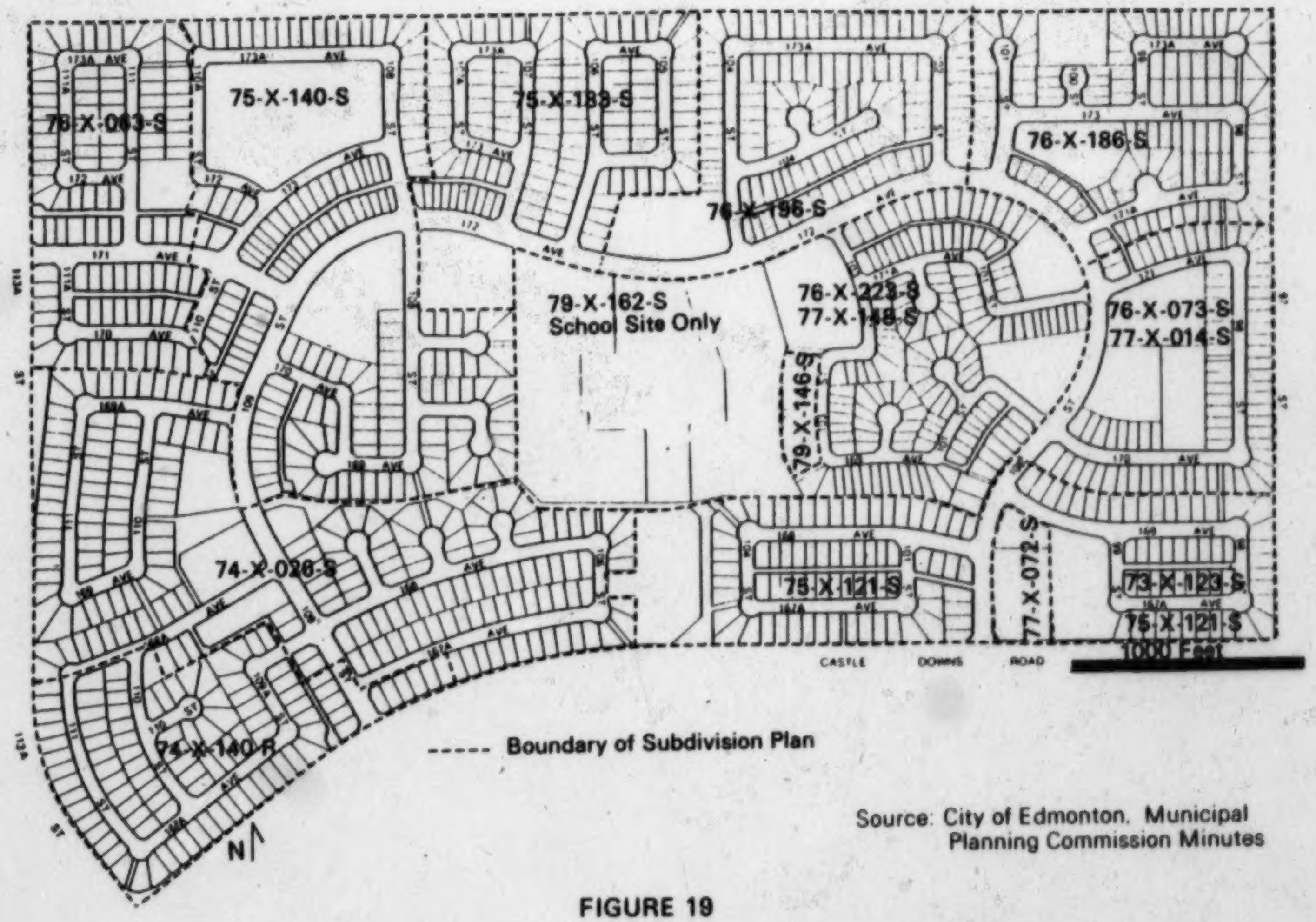
FIGURE 18

APPROVED BATURYN NEIGHBOURHOOD OUTLINE PLAN walking distances could have been achieved. Rear lanes were indicated parallel to the proposed bus route, reducing the potential hazard of front driveways.

At the same time, during the development of the neighbourhood outline plan little thought was given to the activity systems of future residents. At most, concern was expressed about the access to the junior high schools in Neighbourhood 5, and the small parks were located so that most residents would have convenient access to some open space. The two small commercial sites were available for convenience stores, but no neighbourhood centre was planned, forcing future residents to depend heavily on activity opportunities outside the neighbourhood. It was therefore important that there be easy access to these opportunities. The neighbourhood outline plan appeared to take that into account, and if its provisions were closely followed in the detailed subdivision plans there was good reason to expect that public transportation would be well accommodated in the Baturyn neighbourhood.

DETAILED SUBDIVISION PLANS

Subdivision plans for portions of the Baturyn neighbourhood were submitted to the Planning Department from 1973 through 1979 (Figure 19; Table 1). The plans were circulated to the civic departments for criticism and comment. As part of this process, the Engineering, Transportation and Technical Committee, which was comprised of representatives from Transportation Planning and other branches of the


75-X-140-S
75-X-133-S
76-X-063-S
76-X-196-S
76-X-186-S
79-X-162-S
School Site Only
76-X-223-S
77-X-148-S
76-X-073-S
77-X-014-S
79-X-146-S
74-X-026-S
74-X-140-R
75-X-121-S
77-X-072-S
73-X-123-S
75-X-121-S
1000 Feet
CASTLE DOWNS ROAD
113A ST
N
----- Boundary of Subdivision Plan

Source: City of Edmonton, Municipal Planning Commission Minutes

FIGURE 19

DETAILED SUBDIVISION PLANS FOR BATURYN NEIGHBOURHOOD

TABLE 1

DETAILED SUBDIVISION PLANS FOR THE BATURYN NEIGHBOURHOOD

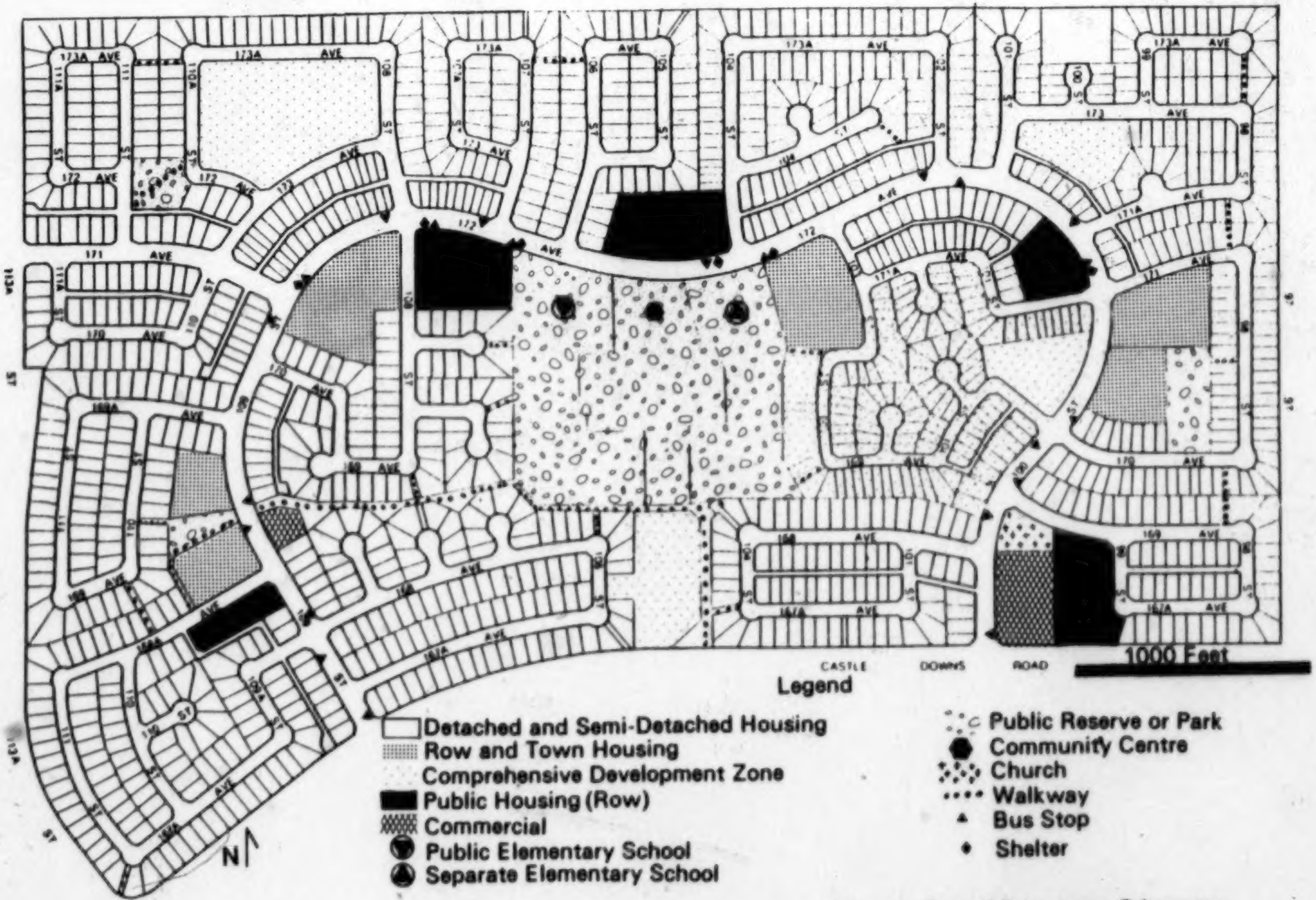
Subdivision Number	Date of Submission	Date of Approval	Comments of Departures From Neighbourhood Outline Plan
73-X-123-S	Nov.28/73	Nov.28/74	Resubmitted as 75X-121-S and 79-X-146-S.
74-X-026-S	Mar.15/74	May 30/74	Walkway added; rear lanes deleted.
74-X-140-R	Nov.14/74	Feb.27/75	
75-X-183-S	Dec.30/75	Feb.12/76	
76-X-063-S	Mar.15./76	May 6/76	Rear lanes paralleling 171 Avenue added.
76-X-186-S	Oct.18/76	Dec.16/76	Road system changed to improve pedestrian access to bus stops; comprehensive development zone added.
76-X-196-S	Oct.29/76	Dec.16/76	Bus shelter required.
76-X-073-S	Mar.31/76	May 6/76	Resubmitted as 77-X-014-S.
76-X-223-S	Dec.14/76	June 2/77	Cluster, town and detached housing included; walkway added; resubmitted as 77-X-148-S.
77-X-014-S	Jan.17/77	Feb.10/77	Number of detached dwellings reduced.
77-X-148-S	Oct.3/77	Dec.22/77	Improved pedestrian access to bus stops; shelter required; zero lot line housing included. Resubmitted as 79-X-146-S.
79-X-146-S	Fall/79	Nov.22/79	Cluster and town housing replaced by detached and semi-detached housing.
79-X-162-S	Nov.5/79	Dec.13/79	

Engineering Department and from Edmonton Transit, met to co-ordinate their comments on these and other submitted plans. The committee's recommendations were forwarded to the Planning Department over the City Engineer's signature.

On the whole, subdivision plans conformed to the neighbourhood outline plan, with some minor changes to the local road system and housing types. Issues related to public transportation were restricted to such matters as road sizing and the need for straight-faced curbs along the bus route, the provision of lanes paralleling bus routes to allow for rear garage access, adequate pedestrian access to bus stops, and the location of bus stops. After August 11, 1976, when City Council amended the development agreement regulations to require developers to contribute to the construction of bus shelters, the Engineering, Transportation and Technical Committee also asked that shelters be provided where bus stops were adjacent to multiple family housing. Seven shelters were requested in all.

Final bus stop locations were 450 to 800 feet apart, substantially closer together than indicated in the neighbourhood outline plan (Figure 20). Only three small areas remained beyond 1300 feet walking distance, and if service was extended along 171 Avenue west of 109 Street only one area would remain beyond the prescribed maximum walking distance. It appears that although bus stops can be located generally in the neighbourhood outline plan, final location must occur at the detailed subdivision plan stage when pedestrian access and the local road system are also finalized.

The issue of rear lanes appears to have been contentious and it


Legend
Detached and Semi-Detached Housing
Row and Town Housing
Comprehensive Development Zone
Public Housing (Row)
Commercial
Public Elementary School
Separate Elementary School
Public Reserve or Park
Community Centre
Church
Walkway
Bus Stop
Shelter
CASTLE DOWNS ROAD
1000 Feet
N
173A AVE
172 AVE
171 AVE
170 AVE
169 AVE
168A AVE
167A AVE
113A ST
97 ST

Source: City of Edmonton, Edmonton Transit Files, (1976)

FIGURE 20

LOCATION OF BUS STOPS

was debated at length for subdivisions elsewhere in Castle Downs (Municipal Planning Commission Minutes, November 10, 1977). Opponents to rear lanes argued that the housing trend was towards garages attached to the fronts of houses, and that the additional cost of paved lanes that were not used for utility services could not be warranted. Edmonton Transit insisted that bus operations were safer when automobile access from private dwellings onto bus routes was restricted. In Baturyn, however, the Municipal Planning Commission did not require the addition of rear lanes paralleling the bus route if lanes were not indicated in the neighbourhood outline plan.

CONCLUSION

Public transportation considerations affected all three levels of planning for Castle Downs. At the district outline plan stage, the collector road system was designed to allow for continuity in bus routing and the location of the district campus was determined by the desire to provide effective transit service. At the neighbourhood level, multiple family housing and commercial sites were positioned along the bus route, and rear lanes were indicated paralleling streets that would be used for transit service. Pedestrian access to bus stops and rear lanes were ensured at the detailed subdivision plan stage. It appears that the need for rear lanes must be established in the neighbourhood plan if they are to have any chance of being built, but even then there is no guarantee that they will in fact be built.

The Baturyn neighbourhood was similar in concept to Perry's neighbourhood unit. Arterial and collector streets bounded three sides; the largest commercial site was located in the corner of the neighbourhood, at a major intersection; and the size was based on elementary school catchment areas. However, no true neighbourhood centre was created. Major walkways gave pedestrian access to park, school and commercial activities within the neighbourhood and provided a connection to Neighbourhood 5. Unlike Stein and Wright's projects, however, most pedestrian access was deliberately placed adjacent to roads. Accommodation of public transportation closely followed Edmonton Transit's criteria of February 19, 1971. Medium density housing was within 750 feet of bus stops; 90 percent of population was within 1300 feet of bus stops; and the major walkway was designed to permit pedestrian access to the junior high schools in Neighbourhood 5. Bus stops were closer together than the proposed 1000 feet.

Consideration of activity systems of future residents appears to have been greatest at the district outline plan stage. However, the continued emphasis on public transit throughout the planning of Baturyn suggests that physical access to activities remained an important issue when the provision of facilities for the activities received less attention. After revisions at all three stages of planning the Baturyn neighbourhood, transit access appears to have been well accommodated. To subject this impression to a more searching test a home survey was used in an attempt to determine if the residents also found the facilities adequate. At the same time, the opportunity was taken to ask the residents how they evaluated the impact of the transit-related design features on neighbourhood quality.

CHAPTER 6

EVALUATION OF THE BATURYN NEIGHBOURHOOD:

A HOUSEHOLD SURVEY

Evaluation of residential planning is made difficult by the length of time that elapses from the planning stage through the construction phase to the eventual occupation of the homes. Commercial facilities, community services and recreational facilities usually are not built or provided until there is a sufficiently large population to support them and funding is available. Planners focus on new projects elsewhere in the urban area and planning policies may change. Nevertheless, evaluation should be attempted so that critical analyses of the effects of policies can be documented and so that lessons learned can improve future planning efforts.

In Edmonton, the General Plan and the Transportation Plan Part I stipulated that consideration should be given to public transportation in the planning of residential areas. This policy was followed in the planning of Castle Downs where it had a significant impact on the physical design: the district campus was located so that good bus service to it was possible; a transit centre was incorporated in the town centre; higher density housing and commercial and community services were located on or close to bus routes; walkways were provided to improve access to bus stops; and the road system was designed to allow efficient bus routes. However, the City of Edmonton has not attempted to evaluate either the effectiveness of such planned features or their acceptance by the residents.

It is difficult to isolate the effect of physical residential design on the use made of bus services. As was stated earlier, transportation must be viewed as a means towards an end rather than as an activity with inherent value. Chapin hypothesized that participation in activities depends upon the propensity and the opportunity to engage in activities. In a modification of his model, it was proposed that motivations, thoughtways and personal characteristics predispose and precondition people when they are considering the use of public transportation, and that the perceived availability and quality of the public transportation determine the opportunity to use the service. It is therefore logical that evaluation of the impact of residential design on public transit use should concentrate on the perceived availability and quality of the service, although preconditioning and predisposing factors cannot be ignored.

Similarly, Hagerstrand theorized that activity patterns were shaped by capability, coupling and societal constraints, and that availability of transportation was one of the most important constraints of all. From the viewpoint of public transit users, capability constraints - the ability to walk to bus stops - appear to be most affected by subdivision design. For the supplier, subdivision design imposes coupling constraints such as scheduling, potential demand, the ease of providing service to desired destinations within the outline plan area and integrating service within the whole public transit system.

Another question that arises is how the application of public transportation policies influences the neighbourhood environment. Do the residents view transit related features as adversely affecting neighbourhood quality and are there unanticipated costs in creating a neighbourhood that allows for efficient, attractive public transit service? Through the analysis of a household survey, the attempt is made to determine the Baturyn residents' perception of transit related features. Using the questionnaire results and an analysis of transit service an attempt is also made to evaluate the impact of the physical design of the Baturyn neighbourhood on some aspects of the provision and use of public transit service during October and November of 1981. Specifically, the questionnaire attempted to determine if the capability constraint of walking distance - an important component of excess travel time - has been minimized.

THE BATURYN NEIGHBOURHOOD IN 1981

At the time of the survey, the Baturyn neighbourhood was almost completely developed (Figure 21). Only four proposed public housing sites, one town house site, one comprehensive development site and a scattering of detached and semi-detached housing sites remained empty. The separate and public elementary schools were both in use; the two small parks and the large central park were landscaped; and all the walkways were constructed. The two commercial sites were developed as well: the western site contained a small grocery store, a fast food outlet and a lounge-restaurant; the larger eastern site housed a small grocery store, two fast food outlets, a bank, a drycleaners, a hair salon, doctors' offices, a real estate office and a gas bar. A

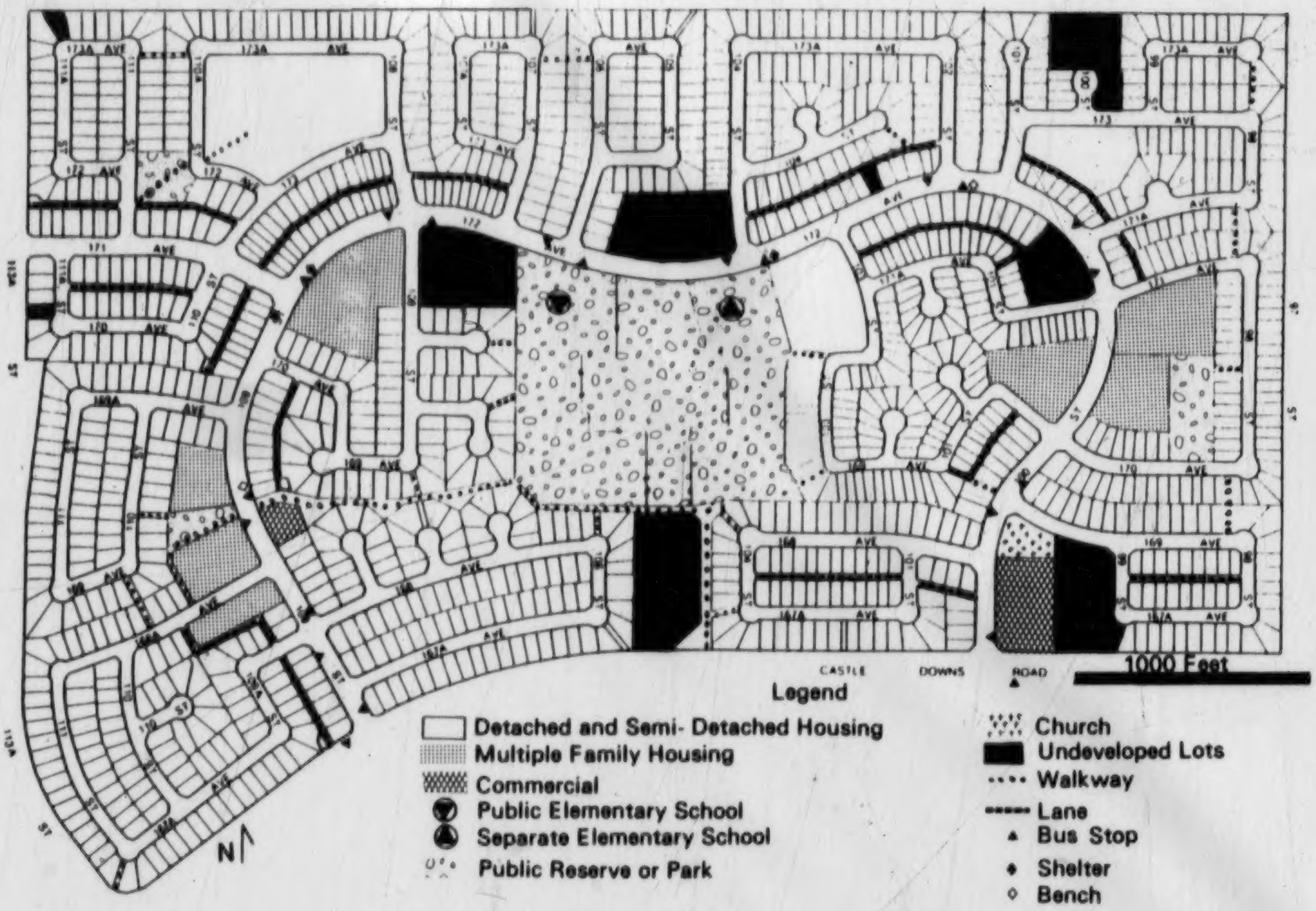

Legend
Detached and Semi- Detached Housing
Multiple Family Housing
Commercial
Public Elementary School
Separate Elementary School
Public Reserve or Park
Church
Undeveloped Lots
Walkway
Lane
Bus Stop
Shelter
Bench
CASTLE DOWNS ROAD
1000 Feet
N
173A AVE
113A ST
97 ST

FIGURE 21

THE BATURYN NEIGHBOURHOOD IN 1981

dentist's office and a church were located adjacent to the eastern commercial site.

Across Castle Downs Road, in Neighbourhood 5, was a larger commercial centre. It contained a major chain grocery store, dental, medical and insurance offices, a gas bar, a drug store, and a savings and credit office. Commercial facilities at the town centre included a major chain grocery store, several small shops, and medical and dental offices. A fire station and a transit centre were located adjacent to the town centre. Two larger, regional shopping centres, North Town Mall at 137 Avenue and 97 Street and Londonderry Mall at 144 Avenue and 66 Street, offered major department stores, a variety of clothing and hardware shops, restaurants and cinemas.

The junior high schools planned for Neighbourhoods 5 and 6 had not as yet been built and the district campus had not been developed. Therefore, students beyond elementary school grades were required to travel outside Castle Downs to attend school. Recreational opportunities other than those offered by the various neighbourhood parks and the man-made lake adjacent to the town centre were non-existent.

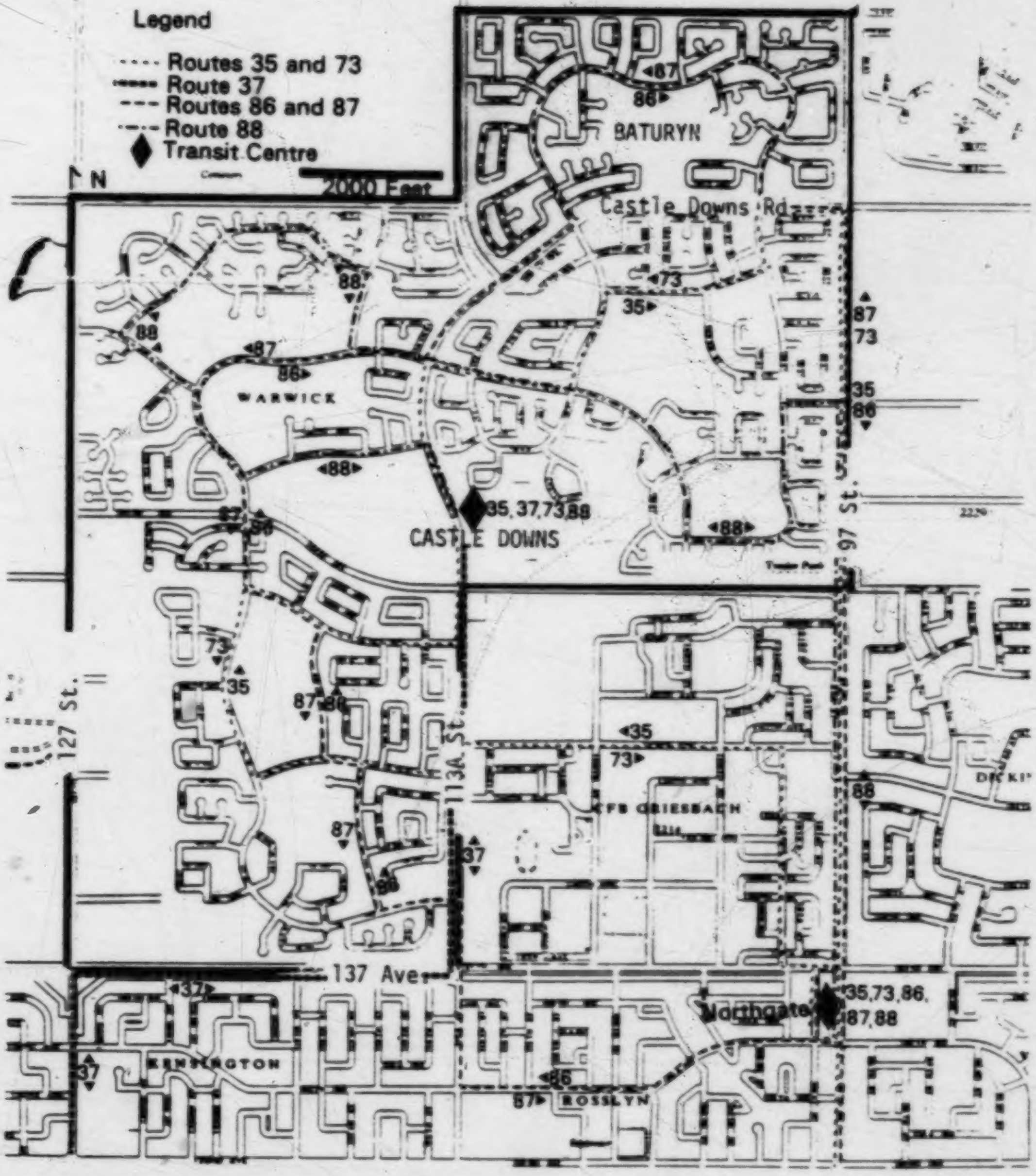
BUS SERVICE IN 1981

As was shown in Chapter 5, the design of Baturyn allowed buses to travel along a collector road through the neighbourhood, stopping only to allow passengers to board or disembark. The lack of traffic lights at both entrances to the neighbourhood (Castle Downs Road at 100 Street and Castle Downs Road at 109 Street) was a potential cause of delays, particularly for left turns. Bus stops were also closer than the suggested 1,000 feet, so travel through the area may have been perceived as slow. However, stops were placed to offer excellent pedestrian access. At the time of the survey two of the proposed six bus shelters were in place. The balance were to be provided when the remaining multiple family dwelling sites were developed. Benches were also located at two stops.

Baturyn was served by two bus routes running in a loop from Northgate Transit Centre at 135 Avenue and 99 Street through Castle Downs (Figure 22). The route configuration resembled the proposals of the 1976 public transit plan for Castle Downs (Figure 14). Route 86 ran clockwise on the loop and continued as an express route on 97 Street to the CBD, except at nights and on Sundays and holidays when it terminated at Northgate Transit Centre. Route 87 ran counterclockwise around the loop and was extended to the CBD only during weekday peak hours. Weekday service began in Baturyn at 5:40 a.m. and the last bus through the neighbourhood was at approximately 12:45 a.m. Frequency of service on both routes was 10 minutes during peak hours, 30 minutes in off-peak hours and hourly late at night. Limited direct service to the Government Centre was offered during peak hours. On weekends, hours of service were shortened and frequencies were reduced to 30 minutes on Saturday and 60 minutes on Saturday evenings and all day Sunday and holidays. Schedules were such that both routes passed through Baturyn at approximately the same time, except when frequencies were 60 minutes. Schedules were then offset in order to maintain a combined frequency of 30 minutes.

FIGURE 22

BUS SERVICE IN CASTLE DOWNS, OCTOBER 1981


Legend
Routes 35 and 73
Route 37
Routes 86 and 87
Route 88
Transit Centre
N
2000 Feet
BATURYN
Castle Downs Rd
WARWICK
35,37,73,88
CASTLE DOWNS
97 St.
127 St.
113A St.
137 Ave
CFB GRIESBACH
Northgate
35,73,86,87,88
KENSINGTON
ROSSLYN
35
37
73
86
87
88

Source: Modified from City of Edmonton.(1981)
"Edmonton Transit Guide, Spring/Summer 1981"

This bus service met the city standards as set out in the Transportation Plan Part I. All but 47 or 3% of the dwellings in Baturyn were within 1300 feet walking distance of a bus stop, and 30 minute frequency of service was available for more than the base periods of 6:30 a.m. to 11:00 p.m. Monday through Saturday and 9:00 a.m. to 11:00 p.m. on Sundays and holidays. Scheduled trip times to the CBD varied from 29 minutes to 36 minutes on Route 86 and 41 to 45 minutes on Route 87, depending on the location of boarding within the neighbourhood. These times met the maximum allowable travel time standard of 45 minutes, although congestion of 97 Street during peak hours most certainly resulted in actual trip times greater than scheduled. Loading information was not available so it is not possible to know if passengers were able to board the first vehicle. The high peak hour frequencies suggest that buses would be full or almost full. Scheduling of the two routes was such that should waiting patrons be passed by a full bus, an eight to ten minute wait for the next bus was necessary. The length of this wait exceeds the five minute standard.

At the Northgate Transit Centre, timed connections were possible with service to most of the major trip attractors and activity centres - Londonderry shopping centre, the Belvedere rapid transit station, the CBD, northeast and northcentral Edmonton, the Northern Alberta Institute of Technology and the University of Alberta. A direct connection was not available to the northwest, west or south-east industrial areas of the city. Neither was direct service available from Baturyn to the Castle Downs town centre. Residents in the southeast corner of the neighbourhood had the option of boarding Routes 35 and 73 at Castle Downs Road and 100 Street, and these routes provided direct service to the Castle Downs town centre, North Town Mall and the CBD.

The bus service in Baturyn in 1981 met city standards and the residents should then have perceived that adequate service was available for most trips. Capability constraints appear to have been minimized as almost all residents were within easy walking distance of a bus stop. Most coupling constraints faced at the origin of a trip also appear to have been minimized. Service was available during the hours when most residents would travel and frequency of service was not less than 30 minutes. Schedules, therefore, should have complemented residents' available windows of time. Excellent bus service was available to Northgate and Downtown, while the shopping centres, educational institutions and recreational sites in the northcentral and northeast areas of the city could be reached with a single transfer. However, access to the industrial areas in the northwest, west and southeast sections of the city required at least two transfers, resulting in long actual and perceived travel times. In addition, trips to Castle Downs town centre entailed a lengthy walk, again increasing perceived and actual travel times over trip times made by automobile. However, in 1982, changes to the Castle Downs bus routes provided Baturyn residents with service through Neighbourhood 5 to the town centre. The route configurations then resembled those proposed by Edmonton Transit in 1971 (Figure 13).

Patrons of public transit, then, possessed smaller space-time prisms than did residents who travelled by private automobile. These smaller prisms reduced employment opportunities in the industrial areas of the city. As well, the shopping, medical and community facilities in the town centre were not readily available for the captive transit rider.

THE QUESTIONNAIRE

Purpose and General Description

The questionnaire had two purposes. First, an attempt was made to determine whether the physical design of the neighbourhood affected the use of public transportation. The intent was to try to separate the effect of the capability constraints imposed on public transportation users from the effects of the preconditioning factors determined from profile data, and from the effects of coupling constraints imposed by the quality of public transit service offered. The questionnaire investigated the use of public transit for work, shopping, personal business, social and recreation trips. Residents' opinions of the availability and quality of public transit facilities were sought.

Second, the questionnaire solicited opinions about the design of the neighbourhood and outline plan area. Particular emphasis was placed on the acceptance of public transit features. A special attempt was made to determine if residents agreed with the planning practice of concentrating multiple family housing, neighbourhood stores and schools near the centres of neighbourhoods, a practice which encourages efficient provision of transit services.

The survey was organized into four parts. First, the opinions of respondents towards general residential design and the design of their own neighbourhood was sought. Question 1 solicited opinions of the planning practice of concentrating higher density housing adjacent to school, park and commercial sites as opposed to mixing housing types throughout a neighbourhood. Respondents were also asked to comment on proposed bus stop locations. Responses were compared with Edmonton Transit's bus stop location practices. In Question 2, respondents were asked to consider the adequacy of school, recreation and commercial facilities, bus, fire and police services, and street safety factors in Castle Downs. Question 3 focused on specific physical design features, most of which related to the provision and operation of public transportation in Baturyn. Residents were asked if the features existed in order to determine if some features, such as bus stops, were easily recognized and so improved the perceived availability of transit service. Awareness of other features, such as rear lanes, straight-faced curbs and the location of multiple family housing, is not important to either the provision of transit service or the perception of service quality, so Question 3 should not have been included in the questionnaire. Residents were then asked how they thought each feature would affect the quality of the residential environment. The purpose here was to determine the residents' opinions of features that Edmonton Transit deemed necessary for efficient transit operations.

The second part of the questionnaire, Questions 4 and 5, pertained to aspects of bus service in Baturyn. Question 4 required residents to agree or disagree with statements regarding bus stops, shelters, the bus route and pedestrian access to bus service. The purpose here was to evaluate the perceived quality of the facilities and to determine if residents found bus service to be intrusive. Using a map of Baturyn, respondents were then asked to trace the usual route taken from their home to the bus stop. The question was intended to assess the use of walkways and the effect of shelters, benches and superior bus service on the distance users were willing to walk.

The questionnaire then turned to the individual household. Questions 6 through 9 dealt with the sex of the respondent, the size of the household, the number of cars available to the household, and the ownership of the home. Question 10 ascertained the type of dwelling but this question was altered during coding to allow respondents to be categorized both by housing type and by walking distance from bus service. Questions 11 through 15 pertained to the presence or absence of rear lanes and front driveways. The intent of the questions was to determine if the respondents had a preference for a particular type of access to their property and if they perceived similar safety problems with front drive access as were identified by Edmonton Transit.

Question 16, the final part of the questionnaire, focused on the individual members of the households. Profile data were obtained by asking age, occupation, and sex. Occupations were grouped using a modification of Pineo and Porter's occupational prestige classification (Pineo and Porter, 1967). A question about income was not included because of anticipated problems of non-response and the difficulty of establishing income strata. As well, respondents were asked if they possessed a valid driving licence. No attempt was made to determine complete activity patterns of the household members because of the time that it would have taken respondents to give such information. Much of the information would not have been relevant to the thesis anyway. Instead, the survey identified a number of activities thought to be part of most activity patterns and respondents were asked to give the mode of travel used in reaching these activities. The effects of destination, purpose of trip, and level of public transit service on choice of mode were analyzed. Finally, respondents were asked to choose their reasons for not using public transit. Response options attempted to segregate the effects of service levels, travel time and destination from the effect of walking distances from the home to the bus stop.

The questionnaire was pretested by members of the executive of the Baturyn community league and Edmonton Transit staff. Minor changes were made as a result of this pretest.

Sampling Method

The survey was distributed to a stratified sample of households. Strata were based on walking distances to bus stops (Figure 23). Stratum A contained households within 650 feet; Stratum B contained households between 650 feet and 1300 feet; and Stratum C contained households beyond 1300 feet of a bus stop. Within Stratum A two

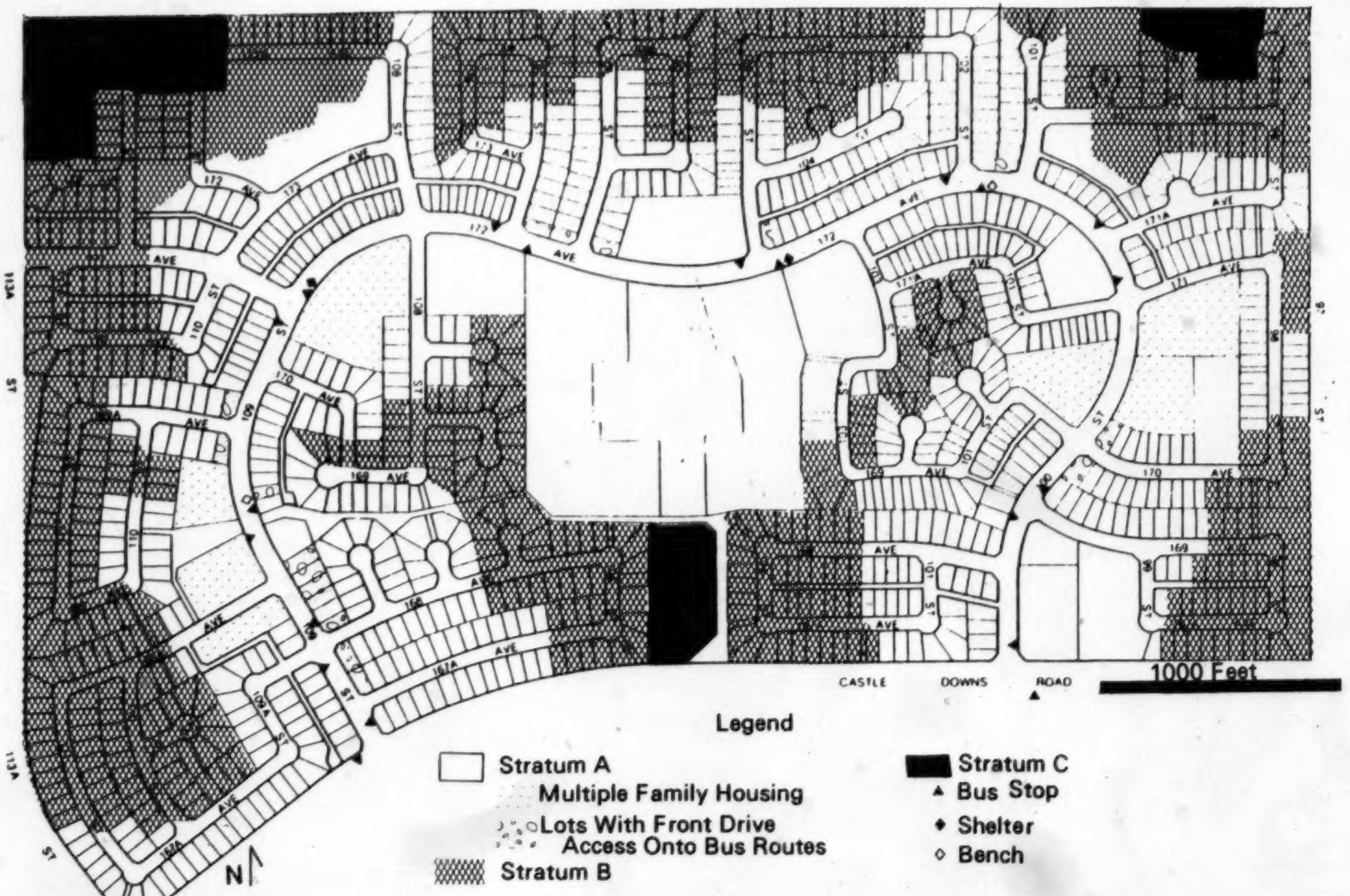

172
AVE
171
110
ST
108
170
169
106
161A
109A
113A
101
102
104
171A
CASTLE DOWNS ROAD
1000 Feet
Legend
Stratum A
Multiple Family Housing
Lots With Front Drive Access Onto Bus Routes
Stratum B
Stratum C
▲ Bus Stop
◆ Shelter
◇ Bench
N

FIGURE 23

SAMPLING STRATA

classes of dwellings were identified separately from the remainder: row or town housing and houses with front drive access onto the collector roadway. This allowed the relationship between multiple family dwellings and modal split to be analyzed, as well as ascertaining residents' perceptions of the hazards of driveway access onto the bus routes.

A 25% sample of all households was deemed to be an acceptable survey population. With an anticipated return of 20%, standard error would be .05. Questionnaires were hand delivered to every fourth house and recipients were given both verbal and written explanations of the nature and purpose of the survey. If residents refused to participate or were not at home, the adjacent household was canvassed. Because of the small number of dwellings with front driveways giving access directly onto the collector roadway, all were canvassed. So, too, were all the dwellings in Stratum C. A date was arranged to pick up the completed survey, at which time a reminder was left if the survey was not ready (see Appendix 1). Four hundred and fourteen of the 1415 households in Baturyn (29.3%) received questionnaires. A total of 268 (64.7%) was returned, resulting in a sample population of 18.9% of all households (Table 2). Standard error was estimated at 0.03.

Response Problems

The first 15 questions tended to be answered by all or almost all respondents. It is difficult to determine the exact response rate for Question 16 as information was solicited only for those persons of

TABLE 2

QUESTIONNAIRE SAMPLE

			Number of Households				
Stratum or Class	Total Number	Number Surveyed	% Surveyed	Number Returned	% Returned	% of Total	% of Sample
A Within 650 feet of a bus stop.	900	235	26.1	160	68.0	17.7	59.7
MF Multiple family dwellings.	196	48	24.5	30	62.5	15.3	11.2
FD Front drive access to bus route.	17	15	88.2	9	66.6	52.9	3.3
B 651 to 1300 feet of a bus stop.	468	135	28.8	85	63.0	18.2	31.7
C Beyond 1300 feet of a bus stop.	47	44	93.6	21	47.7	44.7	7.8
Total	1415	414	29.3	268	64.7	18.9	

school age or older. However, data for at least some of the members of almost all households were obtained. There appeared to be no difficulty understanding instructions with the exception of part i of Question 16. Respondents here were asked to choose and then rank the three most important reasons for not using the bus for various types of trips. The most common error was to rank all choices, a problem that had not surfaced during the pre-test of the questionnaire. In summary, no severe response problems were encountered.

PROFILES OF HOUSEHOLDS AND INDIVIDUALS

(Questions 6-9; 16a-c,e; Tables 3-4)

Household profile statistics are shown in Table 3. Average household size was 3.4 persons, with just over 80% of households consisting of two, three or four persons. Eighty-six percent of the dwellings were owner-occupied. Car ownership was almost universal, and more than two-thirds of the households owned more than one vehicle. The average number of cars per household was 1.8.

Individual profile statistics, shown in Table 4, were solicited only for those household members of school age and older, because the travel behaviour of very young children is not pertinent to the thesis. The profile data are therefore incomplete. Of the sample population of 695 people over 5 years of age, only 7 were older than 65 years. Six hundred and twelve people were 45 years of age or younger, and 121 were between 5 and 15 years of age.

Valid driving licences were held by 71.7% of this population.

TABLE 3

THE QUESTIONNAIRE

HOUSEHOLD PROFILE

A. SIZE OF HOUSEHOLD (Question 7)

	Number of Persons						
	1	2	3	4	5	5+	N
Number of households	6	62	78	74	29	16	265
Percentage distribution	2.3	23.4	29.4	27.9	10.9	5.8	

B. OWNERSHIP OF DWELLING (Question 9)

	Own	Rent	N
Number of households	228	37	265
Percentage distribution	86.0	14.0	

C. CAR OWNERSHIP (Question 8)

	Number of Cars Owned by Household					
	0	1	2	3	3+	N
Number of households	3	79	152	28	3	265
Percentage distribution	1.1	29.8	57.4	10.6	1.1	

TABLE 4

PROFILE OF INDIVIDUAL HOUSEHOLD MEMBERS

A. SEX

	Male	Female	N
Number	361	346	707
Percentage distribution	51.1	48.9	

B. AGE DISTRIBUTION OF SURVEY POPULATION OF SCHOOL AGE OR OLDER

	Years					
	5-15	16-25	26-45	46-65	65+	N
Number	121	164	327	76	7	695

C. POSSESSION OF A VALID DRIVING LICENCE

	Possessed Licence	No Licence	N
Number	503	199	702
Percentage distribution	71.7	28.3	

TABLE 4 (Continued)

PROFILE OF INDIVIDUAL HOUSEHOLD MEMBERS

D. OCCUPATION

	Number	%
Professional; high prestige proprietors, managers and officials	64	9.3
Semi-professional; low prestige proprietors, managers and officials	117	16.9
Clerical and sales	120	17.3
Skilled and semi-skilled	100	14.5
Unskilled	25	3.6
Housewives	88	12.7
School students	139	20.1
Post secondary students	33	4.8
Retired and unemployed	7	1.0

N = 693

When the number of children under the legal driving age is considered, this represents almost 90% of the population of legal driving age.

As would be expected in a new residential area, the population of Baturyn was young. The neighbourhood could be described as middle class with neither high-status nor low-status jobs being held by respondents. The large percentage of home ownership supports this observation. The high car ownership and the large percentage of residents possessing driving licences suggests that few adults would have been likely to depend upon public transit.

THE EXTENT OF PUBLIC TRANSIT USE

The survey concentrated on modal choice for employment and school trips because these are made more frequently and regularly than are shopping, personal business, social and recreation trips. As well, most trips made by public transit are during peak hours to employment and school destinations. Modal choice for shopping, personal business, social and recreational trips is briefly discussed also.

Employment and School Trips (Questions 16 a-f; Tables 5-12; Figure 24)

The survey results identified the effects of capability and coupling constraints and preconditioning and predisposing factors on modal choice for employment and school trips. These are examined here.

Subdivision design and bus stop placement determine the capability constraint of walking distance to public transportation service. Many ridership surveys have indicated that public transit patronage declines as the walking distance to boarding points increases, and in one respect this was the pattern in Baturyn. Of the total transit trips to employment and school, 61.4% were made by respondents living in Stratum A (Table 5). Ridership was lower in Stratum B - 27.7% of all transit trips - and still lower in Stratum C - 10.8% of all transit trips. This distristribution closely resembles the distribution of the total survey population by strata (Table 2). Therefore, in the case of Baturyn, the decrease in the number of transit trips as walking distance increases is a result of the larger number of respondents living in Stratum A than in the other strata. When trips by all modes are examined it is seen that use of regular and school buses combined is highest in Stratum C, where walking distances are greatest (Table 6). These findings suggest three possibilities. First, the neighbourhood design sufficiently minimized the capability constraint of walking distance by ensuring that the majority of the population lived within 650 feet and that only a small number of households were beyond 1300 feet of a bus stop. Second, as Fruin for one has argued (1980), walking distance may not be as important as trip purpose in modal choice decisions, or, third, the proportion of dependent transit users - probably school students - is higher in Stratum C than in the other strata. In all these cases, coupling constraints and preconditioning and predisposing factors were more important than capability constraints as determinants of modal choice.

The coupling constraints of time expenditure, time windows and

TABLE 5

THE EFFECT OF WALKING DISTANCE ON PUBLIC TRANSIT PATRONAGE FOR EMPLOYMENT AND SCHOOL TRIPS

	Percentage Distribution of Transit Patrons From Each Stratum (Walking Distance)				
	A (0'-650')	B (651'-1300')	C (>1300')	MF (0'-650')	N
Total transit trips	61.4	27.7	10.8	15.1	166
Regular bus	61.8	29.0	9.2	14.5	131
School bus	59.9	22.9	17.1	17.1	35

TABLE 6

MODAL CHOICE BY STRATA AND CLASS FOR EMPLOYMENT AND SCHOOL TRIPS

	Percentage Distribution of Respondents					
Stratum or Class (Walking Distance)	Auto Drive	Auto Passenger	School Bus	Regular Bus	Other	N
A (0'-650')	53.4	10.9	5.9	22.6	7.3	358
B (651'-1300')	59.0	9.0	4.0	19.0	9.0	200
C (>1300')	53.7	3.7	11.1	22.2	9.3	54
MF (0'-650')	43.5	11.6	8.7	27.5	8.7	69
TOTAL	55.2	9.6	5.7	21.4	8.0	
N	338	59	35	131	49	

ease of travel vary with trip destinations. As was stated above, bus service from Baturyn to some parts of the city entailed multiple transfers and lengthy journeys. Therefore it is not surprising that employment and school locations appeared to affect modal choice for the residents of Baturyn (Table 7; Figure 24). As would be expected, a high percentage of trips within Castle Downs (45.5%) were made on foot or by bicycle. Of the trips to the CBD, 45.9% were made by public transit. The direct, frequent bus service, traffic congestion and parking costs probably discouraged the use of automobiles for these trips. Of the trips to the north-central area, 43.8% were made by public transit. Here the large number of school trips by both school and regular bus services and the fact that trips were short, requiring a single transfer at the most, would account for the high use of public transit. All trips to the southwest and west areas of the city were made by automobile, as were most of the trips to the southeast, northeast and outside the city. Respondents who travelled to multiple destinations each day also relied on private modes almost exclusively. Use of public transit for all these journeys would have involved multiple transfers with attendant waiting times and long in-vehicle trips. Although lengthy, 21.4% of journeys to the University of Alberta were made by bus, probably because a single, timed transfer at Northgate Transit Centre was available and because most patrons were students. In summary, where coupling constraints were minimized by frequent service, direct service or a single timed transfer, residents were more inclined to travel by public transit.

When attention was turned to preconditioning and predisposing

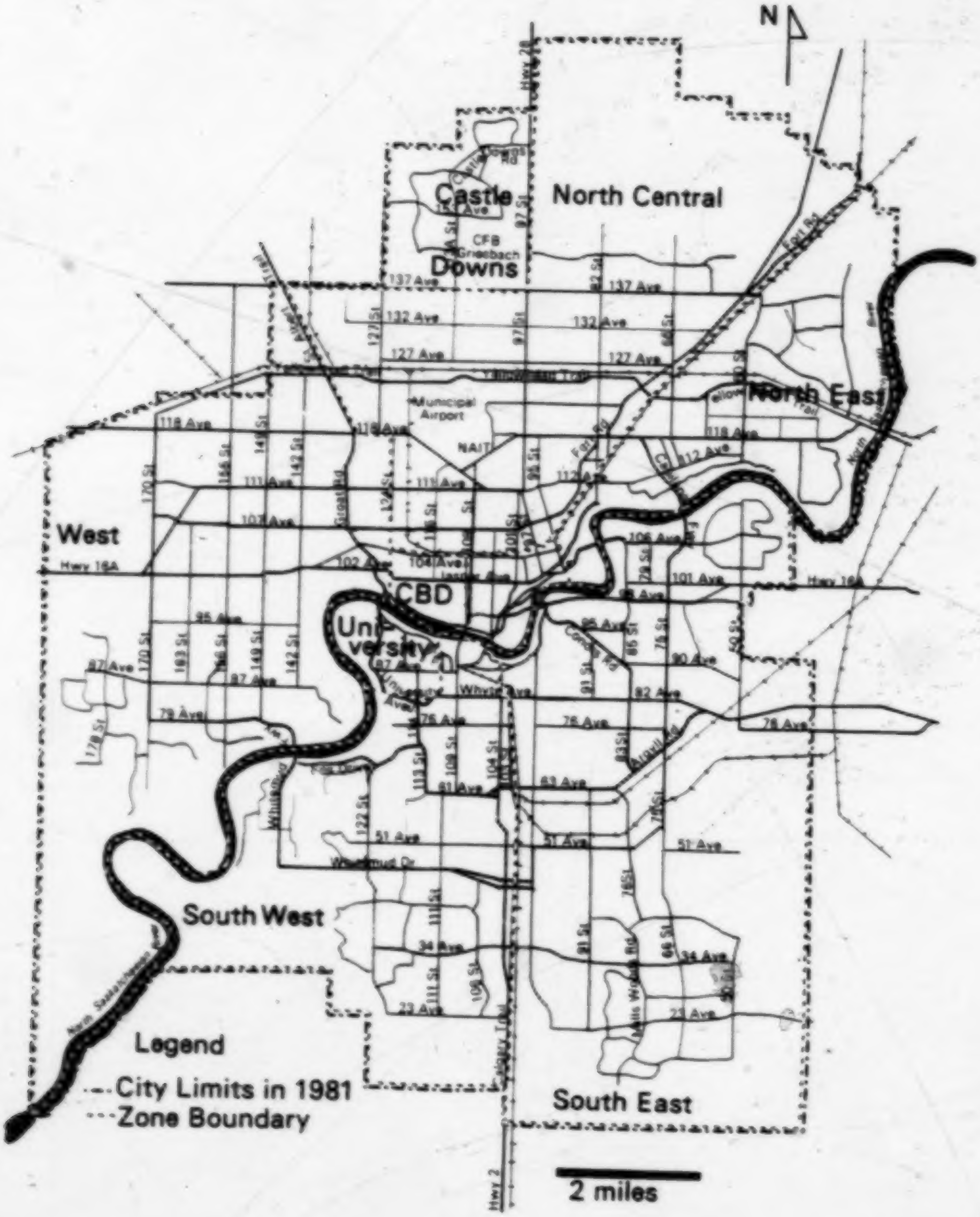
TABLE 7

MODAL CHOICE BY DESTINATION FOR EMPLOYMENT AND SCHOOL TRIPS

	Number (and Percentage Distribution) of Respondents					
Destination	Auto Driver	Auto Passenger	School Bus	Regular Bus	Other	N
Castle Downs	23 (22.8)	17 (16.8)	3 (3.0)	12 (11.9)	46 (45.5)	101
North-Central	80 (49.4)	10 (6.2)	26 (16.0)	45 (27.8)	1 (0.6)	162
Northeast	12 (85.7)	-	-	2 (14.3)	-	14
CBD	44 (44.9)	9 (9.2)	-	45 (45.9)	-	98
West	57 (91.9)	5 (8.1)	-	-	-	62
University	18 (64.3)	4 (14.3)	-	6 (21.4)	-	28
Southwest	5 (83.3)	1 (16.7)	-	-	-	6
Southeast	24 (77.4)	4 (12.9)	1 (3.2)	2 (6.5)	-	31
Outside city	15 (83.3)	-	-	3 (16.7)	-	18
Travels about	20 (87.0)	-	1 (4.3)	2 (8.7)	-	23

FIGURE 24

DESTINATION ZONES FOR EMPLOYMENT AND SCHOOL TRIPS


N
Castle Downs
North Central
North East
West
CBD
University
South West
South East
Municipal Airport
NAIT
CFB Griesbach
137 Ave
132 Ave
127 Ave
118 Ave
111 Ave
107 Ave
102 Ave
101 Ave
Hwy 16A
95 Ave
87 Ave
82 Ave
Whyte Ave
79 Ave
76 Ave
63 Ave
51 Ave
34 Ave
23 Ave
170 St
97 St
Hwy 28
Hwy 2
Calgary Trail
Fort Rd
Whitemud Dr
North Saskatchewan River
Legend
City Limits in 1981
Zone Boundary
2 miles

factors it was found, first, that females were twice as likely as males to use public transportation or to walk. They were also more likely to be passengers in automobiles (Table 8). Age was another critical factor (Table 9). Respondents 15 years of age or younger were most likely to use public transit, walk or ride bicycles to school and, as can be expected, this age group accounted for 77% of school bus users. Those respondents who were 16 to 25 years of age tended to use regular public transit (37.5%) or to drive (45.8%). Almost 80% of respondents between 26 and 45 years of age and between 46 and 65 years of age were drivers, although 14.0% and 17.2% of each group, respectively, used public transportation (Table 10). The sample population for people over 65 years of age was too small to draw conclusions. The above data support Shortreed and Miller who found that 60% to 80% of transit riders in Toronto were female and that passengers younger than 21 years accounted for approximately 49% of the total ridership.

The relationship between modal split and occupation is shown in Table 11. Students and workers in 'Clerical and Sales' occupations patronized public transportation to a much higher degree than did other respondents. Between 34% and 50% of these groups used the bus while over 80% of all other respondents either drove themselves or were passengers in private vehicles. From these data it is not possible either to support or refute Williams' findings (1978) that white-collar workers are more likely to travel by auto than blue-collar workers. There was, however, a positive relationship between the number of cars per household and the likelihood of travelling to

TABLE 8

THE EFFECT OF SEX ON MODAL CHOICE FOR EMPLOYMENT AND SCHOOL TRIPS

	Percentage Distribution of Respondents Choosing Modes					
Sex	Auto Driver	Auto Passenger	School Bus	Regular Bus	Other	N
Female	38.2	12.4	7.2	31.1	11.2	251
Male	67.2	7.1	4.8	15.0	5.9	354

TABLE 9

THE EFFECT OF AGE ON MODAL SPLIT FOR EMPLOYMENT AND SCHOOL TRIPS

Age in Years	Percentage Distribution of Respondents Choosing Modes					
	Auto Driver	Auto Passenger	School Bus	Regular Bus	Other	N
Under 15	1.7	15.3	22.9	22.0	38.1	118
16 to 25	45.8	12.5	4.2	37.5	0.0	144
26 to 45	77.8	6.7	0.7	13.3	1.5	270
46-65	78.1	4.7	0.0	17.2	0.0	64
Over 65	0.0	0.0	0.0	100.0	0.0	1

TABLE 10

AGE OF RESPONDENTS USING MODE

Mode	Percentage Distribution of Respondents					
	Under 15	16-25	26-45	46-65	Over 65	N
Auto driver	0.6	20.1	64.0	15.2	-	328
Auto passenger	31.6	31.6	31.6	5.3	-	57
School bus	77.1	17.1	5.7	-	-	35
Regular bus	20.3	42.2	28.1	8.6	0.8	128
Other	91.8	-	8.2	-	-	49

TABLE 11

THE EFFECT OF OCCUPATION ON MODAL SPLIT FOR EMPLOYMENT AND SCHOOL TRIPS

	Percentage of Respondents Choosing Mode					
Occupation Class	Auto Driver	Auto Passenger	School Bus	Regular Bus	Other	N
Professional; high prestige proprietors, managers and officials	71.9	9.4	1.6	14.1	3.1	64
Semi-professional; low prestige proprietors, managers and officials	87.7	2.6		8.8	0.9	114
Clerical and sales	54.2	10.8	0.8	33.3	0.8	120
Skilled and semi-skilled	79.6	7.1	1.0	12.2	-	98
Unskilled	76.0	8.0	-	16.0	-	25
School students	4.5	13.4	23.1	27.6	31.3	134
Post-secondary students	48.5	12.1	-	39.4	-	33

school or work by automobile (Table 12). This agrees with the findings of Pushkarev and Zupan (1979) and Williams (1978). Respondents who lived in row or town housing were also more likely to be transit patrons and less likely to be automobile drivers than were respondents who lived in detached and semi-detached houses (Table 6). This supports Pushkarev and Zupan's finding that higher density housing generates more transit users.

From the above results the conclusion is drawn that capability constraints were not a factor in public transit use for employment and school trips among the survey population. Coupling constraints arising from the public transit network and timetable, and the preconditioning and predisposing factors of age, sex and car ownership, were more important factors determining modal split.

Shopping Trips (Questions 16f-g; Tables 13-15).

In general, the frequency with which the survey population patronized a shopping centre decreased as the distance to the shopping centre increased. For example, patronage of the Baturyn neighbourhood shopping centres and the Castle Downs town centre was high on a daily and weekly basis, while patronage of North Town and Londonderry malls tended to be one to three times per month. Although the CBD was patronized most for occasional shopping trips, a relatively large number of respondents shopped there frequently. These were probably people who worked in the downtown area.

Public transportation was rarely used for shopping trips (Table 14), except in the case of the CBD where 32.8% of trips were made by

TABLE 12

THE EFFECT OF HOUSEHOLD CAR OWNERSHIP ON MODAL SPLIT FOR EMPLOYMENT AND SCHOOL TRIPS

	Percentage Distribution of Respondents Choosing Mode					
Number of Cars Owned by Household	Auto Driver	Auto Passenger	School Bus	Regular Bus	Other	N
0	22.2	11.1	33.3	33.3	-	9
1	40.0	12.4	5.3	28.8	13.5	170
2	61.4	8.0	5.6	19.0	5.9	337
3	60.5	11.6	4.7	16.3	7.0	86
More than 3	88.9	-	-	11.1	-	9

TABLE 13

FREQUENCY OF SHOPPING TRIPS

Destination	3-7 times weekly	1-2 times weekly	1-3 times monthly	Occasionally	N
Baturyn neighbourhood stores	101	298	121	34	554
Castle Downs town centre	26	301	193	30	550
North Town mall	32	168	284	53	537
Londonderry mall	16	70	346	94	526
CBD	43	56	140	192	431
South Edmonton	8	10	12	2	32
Other	7	24	46	5	8

TABLE 14

MODAL SPLIT FOR SHOPPING TRIPS

(IN PERCENTAGES)

Destination	Car	Bus	Bus and Car	Walk	N
Baturyn neighbourhood stores	59.3	2.7	0.2	37.7	549
Castle Downs town centre	91.5	4.2	1.1	3.1	544
North Town mall	84.1	10.5	3.0	2.4	532
Londonderry mall	90.5	6.5	1.9	1.1	523
CBD	65.1	27.1	5.7	2.1	421
South Edmonton	79.3	10.3	3.4	6.9	29
Other	91.7	3.6	1.2	3.6	84

bus. This was no doubt encouraged by such factors as traffic congestion, cost of parking and direct bus service, but many of the shopping trips to the CBD were probably combined with daily employment journeys by bus. The same reasoning applies to shopping trips by bus to the south side of the city.

The very low use of public transit for trips to the Castle Downs town centre can be partially attributed to the indirect bus service (Figure 22). By contrast, the availability of a short bus trip to North Town Mall probably accounts for the relatively large percentage of shopping trips made there by public transit. Walking or bicycle were important modes only for trips to neighbourhood stores and, even here, 59.3% of respondents used their automobiles.

Tables 15 and 16 show the relationships between modal split to these shopping centres and the walking distance to bus stops and the sex of the public transit patrons, respectively. Public transit use for trips to the remaining shopping centres was not high enough to warrant detailed analysis. Bus patronage, as a percentage of trips made from each stratum, decreased as distance to bus stops increased for trips to the Castle Downs town centre, North Town Mall and the CBD. In all cases the tendency for residents of town and row housing to use public transit was substantially higher than it was for other residents. Females were approximately twice as likely to use the bus as males, and females made up approximately 70% of all bus patrons on shopping trips.

In summary, the capability constraint of walking distance may affect modal choice in the case of shopping trips. Coupling

TABLE 15

THE EFFECT OF WALKING DISTANCE ON THE USE OF PUBLIC TRANSIT FOR SHOPPING TRIPS

Destination	Bus Trips as a Percentage of All Shopping Trips From Each Stratum (Walking Distance) A (0'-650')	B (651'-1300')	C (>1300')	MF (0'-1300')
Castle Downs town centre	6.5	4.1	2.1	16.4
North Town mall	14.5	13.2	8.3	26.7
CBD	35.5	31.8	19.5	53.3

TABLE 16

THE SEX OF RESPONDENTS USING PUBLIC TRANSIT FOR SHOPPING TRIPS

	Bus Trips as Percentage Of All Shopping Trips			Percentage of Bus Patrons		
Destination	M	F	N	M	F	N
North Town mall	8.0	18.4	442	30.0	70.0	70
CBD	22.6	42.3	268	31.9	68.1	138

constraints arising from the bus network and timetables certainly affect modal choice as was shown in transit use to the Castle Downs town centre. However, preconditioning and predisposing factors are the most important determinants of modal choice for shopping trips. Sex and housing type were shown to influence the use of public transit. The high use of private transportation suggests that, because many shopping trips would occur on the evenings or on weekends, automobile availability was not a problem.

Other Trips (Question 16h; Table 17).

The use of the bus on trips for personal business, recreation and social purposes was slightly higher than for shopping journeys but still markedly lower than for school and employment trips (Table 17). The distance from home to bus stops did not appear to affect modal choice but, once again, respondents in town housing and row housing and female respondents were more likely to use public transportation.

Discussion

From the above analyses of modal split for employment, school, shopping, personal business, recreational and social trips, it can be concluded that the design of the Baturyn neighbourhood has successfully minimized walking distances . Therefore, the capability constraint of walking distance from the home to a bus stop was not an important factor influencing the use of public transportation by the survey population. However, coupling constraints, arising from the bus network and timetables, were important modal determinants,

TABLE 17

THE EFFECTS OF WALKING DISTANCE AND SEX ON MODAL CHOICE FOR SELECTED TRIP PURPOSES

Percentage Distribution of Respondents Using Public Transit

	Stratum / Class					Sex		Total	
Trip Purpose	A	B	C	MF	N	M	F	%	N
Employment and school	28.5	23.0	33.3	36.2	612	19.8	38.3	27.1	164
Shopping - North Town mall	14.5	13.2	8.3	26.7	532	8.0	18.4	13.5	72
Shopping - Castle Downs town centre	6.5	4.1	2.1	16.4	544	3.0	7.1	5.3	29
Shopping - CBD	35.5	31.8	19.5	53.3	421	22.6	42.3	32.8	138
Personal business	17.2	17.2	17.7	25.0	684	9.3	22.0	17.3	118
Social	10.1	15.4	10.2	16.3	680	9.3	14.4	11.9	81
Recreation	13.5	17.8	8.3	21.9	663	4.5	7.5	14.5	96

particularly for employment and school trips, and to a lesser extent for shopping trips to the Castle Downs town centre. In particular, the lack of convenient bus service from Castle Downs excludes transit dependents from employment opportunities in the industrial areas of the city. In terms of Hagerstrand's concept, because of coupling constraints these people have significantly smaller space-time prisms than do people with access to private transportation.

Preconditioning and predisposing factors were shown to affect modal split greatly. The survey results indicated that females and the young were the most frequent users of public transportation and these findings were consistent with work done by other public transit researchers. These two groups of transit users also include some of the people who are most affected by the capability constraints of walking and the walking environment. As well, the coupling constraints of transferring and lengthy waiting times could be difficult for children. Residential design can reduce the limitations of these constraints by minimizing the walking distances to bus stops, as was done in Baturyn, and by ensuring a safe walking environment. If diverse activities are grouped in shopping centres or town centres, a transit authority may be able to focus service on these centres, reducing coupling constraints. Residents may then be able to fulfill numerous tasks at one destination.

For all trip purposes, public transit patronage was highest amongst survey respondents who lived in multiple family housing. Because the proportion of automobile drivers was also lowest, the conclusion is made that this group had the highest proportion of public transit dependants of all the survey strata and classes. Therefore, the Edmonton Transit principle that multiple family housing should be located close to bus service appears to be well founded and the City of Edmonton practice of concentrating multiple family housing along collector roads should be continued.

Finally, the survey results indicated that as car ownership increased, the use of public transit decreased. This suggests that as long as car ownership remains at a high level, private transportation will be chosen by the majority of the population.

Perceived Quality and Availability of Public Transit Facilities and Services (Questions 2c, 16i; Table 18)

Chapin proposed that the perceived quality and availability of facilities and services determines the opportunity to engage in activities. Through the questionnaire survey, opinions of the bus service in Baturyn were sought so that a comparison could be made between its perceived quality and accessibility and the use that was said to be made of it. In answering the general question, how well is Castle Downs provided with bus service, 76.1% of 259 respondents judged the service to be adequate; 1.5% thought the service to be more than adequate; and 22.4% felt that the service did not meet the needs of Castle Downs. Unfortunately there was no follow-up question asking how service could be improved. Also, the coding of the questionnaire responses made it impossible to determine whether it was transit users or non-transit users, males or females, or residents of a particular age group who were the most dissatisfied with the bus service.

However, the level of approval of service was reflected in the modal split for employment and school trips. Of the surveyed residents, 27.1% used public transit and this is a reasonably high proportion for North American cities.

Non-transit users were asked to choose from a list of six statements the three most important reasons for not using public transit for each of the various types of trips. The choices were then weighted and tabulated; a value of three was given to the first choice, two to the second choice, and one to the third choice (Table 18). The availability of a car was ranked the most important reason for shunning public transit, although it was slightly less important for work trips than for other trips. The length of the bus trip was ranked second in all cases, and an inadequate frequency of service ranked third for shopping and personal business trips. For employment and school trips, the lack of bus service to the desired destination was the third most important reason but the frequency of service was a close fourth. Although not listed, some respondents indicated that the difficulty of carrying parcels or taking small children on the bus was important, particularly for shopping trips. The distance to a bus stop was not ranked highly as a deterrent for bus use.

From the above responses it appears that the walking distance to a bus stop was not perceived as a constraint in public transit use. This agrees with the conclusions drawn from Tables 6 and 17 that walking distance did not affect the use of public transit for employment, school, personal business, social or recreational trips. Capability constraints were perceived as important when small children

TABLE 18

RANKING OF REASONS FOR NOT USING PUBLIC TRANSIT BY TRIP PURPOSE

	Trip Purpose		
Reason	Employment or School	Shopping	Doctor, Friends Library, etc.
A car is available for the trip.	774	1106	1029
The bus takes too long.	465	521	545
Bus service is too infrequent.	331	381	382
The bus does not travel to the destination.	341	240	328
The destination is within walking or cycling distance.	224	241	225
The nearest bus stop is too far from home.	86	148	146
Using the bus is difficult with small children and/or parcels.	40	124	34
Other	121	104	88

were accompanying the respondent or when parcels were carried. This supports the conclusion drawn from Table 15 that modal choice for shopping trips is affected by capability constraints.

Coupling constraints associated with the attributes of the transit system, rather than capability constraints, were perceived as the main disadvantages associated with public transit. Trip length, frequency of service and, in the case of employment and school trips, the lack of service to desired destinations were perceived as deterrents. These perceptions were reflected in the use of public transit (Tables 7 and 14). Where lengthy bus trips were involved or where service was infrequent, public transit use was low; for example few bus trips were made to the southeast, southwest, northeast, west and the industrial areas of the city and to distant shopping centres.

The convenience of the automobile was perceived as the overwhelming factor in modal choice. The automobile is usually faster than public transportation, frequency of service is not a problem and the automobile can go to almost anywhere within the city as well as beyond the city boundaries. It is not surprising, therefore, that as automobile ownership increased and the residents had a choice of mode, public transit use declined (Table 12).

DESIGN OF RESIDENTIAL AREAS

Subdivision design affects the ability to provide a high quality, easily accessible public transportation service. In reviewing the plans for Castle Downs and Baturyn, Edmonton Transit requested that certain features related to transit operations, land use and pedestrian access to transit service be included. First, they required a collector road system that would permit the bus routes to be visible and reasonably direct while minimizing walking distance to bus stops. Straight-faced curbs were desired along the collector roads to facilitate snow clearance and insure pedestrian safety. Abutting detached and semi-detached houses were to have vehicular access by rear lanes rather than front drives in order to remove the potential for conflict between bus traffic and ingressing or egressing vehicles. With regard to land use, Edmonton Transit preferred multiple family housing to be located along the bus route to minimize walking distances for the maximum number of patrons. Commercial facilities and schools were also to be situated on the bus route so that optimal accessibility by public transit could be provided. Third, Edmonton Transit determined bus stop and shelter location during the subdivision plan stage. As well, they requested that sidewalks and walkways be oriented to provide maximum accessibility to bus services. Good street lighting is also important if there is to be safe access to bus services. A question about street lighting was therefore included in the questionnaire, although it is not a feature on which Edmonton Transit commented during the planning of Castle Downs and Baturyn.

The questionnaire sought to determine if these transit-oriented features affected the respondents' perception of the quality of the neighbourhood. Questions that pertained to the awareness of lanes, streetcurbs, and multiple family housing location, as well as questions that pertained to police and fire protection, underground utilities, land barriers and berms, parks, and key-hole crescents, proved to be irrelevant to the thesis. They should not have been included in the questionnaire and have been omitted from the analysis below.

Transit Operations(Questions 3a,e,f,p, 11-15; Tables 19-20)

Of 258 respondents, 92.0% recognized that there was a main road running through Baturyn, and 4.9% were unaware of the main road. The awareness may have enhanced the perceived availability of bus service.

Just over half of the respondents approved of a single main road and rolled curbs while most of the remaining respondents felt that these features made no difference to the quality of the neighbourhood (Table 19). The strongest dislike shown was for straight-faced curbs; 34.0% of respondents believed the curbs detracted from neighbourhood quality yet 53.4% felt they did not.

The practice of designing neighbourhoods with a single collector road is a departure from Perry's concept of a neighbourhood unit but it was proposed by the American Public Health Association (1960) and strongly endorsed by CMHC (1981). The single collector road also met with the approval both of Baturyn residents and of Edmonton Transit. The collector road provided an easily identifiable and efficient bus route. Edmonton Transit's preference for straight-faced rather than rolled curbs was not shared by residents who perhaps were not aware of the problems of snow removal or of buses riding up and over rolled

TABLE 19

TRANSIT OPERATIONS AND NEIGHBOURHOOD DESIGN

How would the following features affect the quality of Baturyn?

Feature	Percentage Distribution of Responses Take Away	Add	No Difference	N
Alleys and lanes	13.5	45.2	41.3	252
Straight-faced street curbs	34.0	12.6	53.4	247
Rolled street curbs	3.6	53.6	42.7	248
One main road through the neighbourhood	13.4	58.3	28.3	254

curbs.

While 45.2% of the survey respondents thought lanes added to the quality of the neighbourhood, 41.3% felt lanes had no effect on neighbourhood quality. Only 25.6% (or 60 respondents) agreed that the presence or absence of a lane affected their choice of home location (Table 20), although the presence of a lane was important to 50.9% of respondents who chose a location with a lane. The absence of a lane was important to only 18% of residents who chose sites without lanes. Most of the 23.6% of respondents who had a lane adjacent to their home used it for vehicle access.

Residents without rear lanes were required to carry garbage to the front curb for collection. Only 22.4% of these people expressed dissatisfaction with this arrangement, the most common complaint being that dogs scattered the garbage. Because the same question was not asked of all residents it is not possible to determine if residents with rear garbage pick-up avoided this problem.

Edmonton Transit insisted on rear lanes on streets paralleling bus routes on the grounds of safe bus operation, but the above results suggest that many residents also approved of their provision. The questionnaire attempted to establish if residents perceived the potential for safety problems when backing out of front driveways (Table 20). Only one-third or 69 of the respondents with front drives expressed concern about backing their vehicles onto the street. The safety of children was the most common worry. There were also complaints that snow was left in front of the drive after the streets had been cleared.

TABLE 20

REAR LANES

A. EXISTENCE OF REAR LANES

Question	Percentage Distribution of Responses Yes	No	N
Is there a rear lane or alley behind your house?	23.6	74.4	234
Was the decision to buy or rent your home affected by the existence or absence of a rear lane?	25.6	74.4	234
Do you have a front drive?	78.6	21.4	234
If you have a front drive, do you have any concerns about backing out of the driveway?	33.7	66.3	205
Is your garbage picked up at the front of your home?	77.6	22.4	232

B. GARBAGE PICK-UP

If garbage is collected at the front of your home and presents problems,what are the problems?

Problem	Percentage Distribution	N
Dogs strew litter	63.5	33
Carrying garbage to curb	11.5	6
Time of collection	7.7	4
Other	1.9	1
More than one of above	15.4	8

TABLE 20 (cont.)

REAR LANES

C. CONCERNS ABOUT BACKING OUT OF DRIVEWAY

Concern	Percentage Distribution	N
Hitting another car	23.2	16
Hitting children	34.8	24
Hitting rolled curbs or snow	23.2	16
Other	11.6	8
More than one of above	7.2	5

Land Use (Question 1a,c,e,i,j, 2a,d-i, 3j,1,o,q,r; Tables 21-22)

The inclusion of multiple family housing in the interiors of suburban residential neighbourhoods is a departure from Perry's neighbourhood unit concept but it has become standard practice in Edmonton and other North American cities and in British cities. The transit industry is in favour of the practice because higher density housing has been shown to generate greater patronage than single family dwellings. In Edmonton, multiple family housing has been located along or close to collector roads, partly to reduce traffic intrusions into predominantly single family subsections of neighbourhoods and partly to maximize pedestrian accessibility to transit service, commercial facilities, schools and parks.

The greatest percentage of the questionnaire respondents felt that it made no difference to the quality of the neighbourhood if multiple family housing was concentrated along the collector road, but more people thought it detracted from the quality of the neighbourhood than thought it was enhancing (Table 21). Respondents did not want apartments to be located amongst detached housing, and the mixing of town housing and row housing with detached and semi-detached housing was only marginally more acceptable. Open spaces to separate different housing types were thought to improve neighbourhood quality by 62.6% of the respondents. In summary, the majority of respondents did not object to the policy of concentrating multiple family housing along the collector roadway but they preferred multiple family housing to be segregated from detached and semi-detached housing with open land to act as a buffer between housing types. From the viewpoint of

TABLE 21

HOUSING LOCATION

How would the following features affect the quality of the Baturyn neighbourhood?

	Percentage Distribution of Responses			
Feature	Take Away	Add	No Difference	N
Open space to separate different housing types	10.9	62.6	26.5	238
Apartments concentrated along main road	36.0	16.0	48.0	250
Row housing and town housing concentrated along main road	35.8	18.1	46.1	254

Statement	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree	N
Apartments should be scattered among detached and semi-detached houses.	29.0	33.7	11.8	21.6	3.9	255
Row housing and town housing should be scattered among detached and semi-detached houses.	28.5	29.6	10.8	26.9	4.2	260

Edmonton Transit, buffers of open land are undesirable because walking distances to bus service would undoubtedly be increased for some residents.

Respondents thought that schools and parks should be located adjacent to all types of housing, but agreement was strongest in the case of apartments (Table 22). Most respondents (77.7%) recognized that the school and neighbourhood park were in the centre of Baturyn and they felt that this was desirable. Fewer respondents (64.9%) recognized the existence of parks and tot lots but almost all believed they enhance neighbourhoods.

The existing elementary schools were thought to be adequate for the needs of Castle Downs, but not the junior and senior high school facilities. This was a reflection of the fact that Baturyn students had to travel out of Castle Downs to attend junior and senior high schools. Approximately 60% of the respondents found day-care facilities to be adequate. Park facilities in Castle Downs were adequate for half of the respondents but community recreation facilities were judged to be lacking. It is also to be expected that there would be a substantial number of recreational trips with destinations outside Castle Downs, but the destinations for recreation trips were not obtained in the survey.

Over 80% of respondents were satisfied with the provision of commercial facilities in Castle Downs (Table 23). They knew of the existence of neighbourhood commercial centres and they felt these enhanced the neighbourhood. The satisfaction with the commercial facilities suggests that residents would patronize the shops, reducing

TABLE 22

LOCATION AND PROVISION OF SCHOOLS AND PARKS

Statement	Percentage Distribution of Responses					
	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree	N
Schools and parks should be located next to apartments.	7.0	38.3	15.2	33.6	39.5	256
Schools and parks should be located next to row and town housing.	4.7	26.3	15.7	47.5	5.9	255
Schools and parks should be located next to detached and semi-detached housing.	1.6	26.0	20.2	45.7	6.6	258

Does the following physical feature exist in Baturyn?

	Percentage Distribution of Responses			
	Yes	No	Don't Know	N
School and park area located in the centre of the neighbourhood	77.7	11.7	10.6	264

How would the following feature affect the quality of the Baturyn neighbourhood?

Feature	Percentage Distribution of Responses			
	Take Away	Add	No difference	N
School and park area located in the centre of the neighbourhood	3.1	80.4	16.5	255

TABLE 22 (cont.)

LOCATION AND PROVISION OF SCHOOLS AND PARKS

How well do the following facilities meet the needs of Castle Downs?

Facility	Percentage Distribution of Responses: Not Well Enough	Well Enough	More Than Enough	N
Open space for family use (parks, green areas)	45.7	52.5	1.6	257
Elementary schools	13.2	84.8	2.1	243
Junior high schools	71.7	27.0	1.3	237
Senior high schools	78.4	20.7	0.8	241
Day care facilities	40.5	58.1	1.3	227
Community recreation facilities	70.0	29.2	0.8	250

TABLE 23

COMMERCIAL FACILITIES

	Percentage Distribution of Responses			
	Not Well Enough	Well Enough	More Than Enough	N
How well do the commercial facilities meet the needs of Castle Downs?	17.6	72.9	9.4	255

	Affect on Area Quality			
	Take Away	Add	No Difference	N
How do the centres affect the quality of the neighbourhood?	4.8	78.5	21.5	251

the frequency of shopping trips outside Castle Downs. The destination data obtained for shopping trips do indeed show that neighbourhood stores were most frequently patronized.

The responses to the questions on land use suggest that Baturyn residents approved of the physical design features and facilities that had been included in their neighbourhood. The land use is also advantageous to Edmonton Transit. The location of multiple family housing provides maximum accessiblity to transit service for the group of residents who use the bus most. The elementary school is within walking distance of the school children, removing a possible need for additional school buses. The 1982 changes to bus route configuration would allow junior and senior high school students to utilize regular transit services when junior high schools and the district campus are built, diminishing the requirement for school buses.

Public Transit Facilities (Questions 1b,d,f-h, 2k, 3c,d,h,m,n, 4g-j, 5; Table 24-26)

Edmonton Transit determined the location of bus stops and shelters during the design stage of the Baturyn neighbourhood. As well, Edmonton Transit influenced the location of walkways. The intent was to provide safe, pedestrian access to bus service within 1300 feet of detached and semi-detached housing and within 600 feet for multiple family housing. Almost all respondents found the bus stops easy to locate.

There was strong agreement among respondents that bus stops should be located adjacent to schools and neighbourhood stores.

Respondents also approved of locating stops adjacent to all types of housing, with greatest approval being given to locations by row or town housing. However, 69.2% of respondents objected to the idea of a bus stop being placed in front of their own home and 59.9% objected to a bus route along the street in front of their home (Table 24). Only 20% of respondents wanted a stop closer to their dwelling and the location of bus stops did not affect the choice of homes for 78.2% of respondents. Just over half of the respondents knew shelters and benches existed at some stops and almost all felt that these facilities added to the quality of the neighbourhood (Table 25). The numbers of shelters and benches provided were thought to be inadequate by 75.5% and 68.1% of the respondents respectively.

Of the respondents who were bus patrons, 89.2% chose to board the bus at the stop nearest their home (Table 26). Of the remaining respondents using the bus, 3.2% chose stops that were at a greater distance but where a shelter was provided, and 7% chose to walk to stops where more service (Routes 35 and 73) was available. Although it was shown that the capability constraint of walking distance did not affect use of public transit for most trips, these responses suggest that most patrons will not walk farther than necessary, even to reach the convenience of improved service or a more pleasant waiting environment. The design of Baturyn was such that sidewalks provided the shortest and most used routes to bus stops for 78% of respondents. Of the remaining public transit users 3.2% used back lanes as well as sidewalks, and 17.1% of patrons used walkways on their journey to a stop. Two respondents (1.3%) avoided using walkways to shorten their

TABLE 24

LOCATION OF BUS STOPS AND BUS SERVICE

Statement	Percentage Distribution of Responses					
	Strongly Disagree	Dis-Agree	No Opinion	Agree	Strongly Agree	N
Bus stops should be located next to apartments.	3.5	21.2	14.9	49.4	11.0	255
Bus stops should be located next to row housing and town housing.	3.5	15.2	18.8	54.3	8.2	256
Bus stops should be located next to detached and semi-detached housing.	2.0	23.6	19.3	48.0	7.1	254
Bus stops should be located next to schools.	1.2	4.0	3.6	51.0	40.3	253
Bus stops should be located next to neighbourhood stores.	1.2	12.4	13.2	53.1	20.2	25
It is easy to find bus stops in Baturyn.	1.9	2.7	6.9	76.2	12.3	260
There are enough bus shelters in Baturyn.	35.2	40.2	14.9	8.4	1.1	261
There are enough benches at bus stops in Baturyn.	27.3	40.8	18.1	13.1	0.8	260
I would like a bus stop closer to my home.	8.5	28.8	42.7	15.8	4.2	260
Sidewalks and walkways provided a safe route from my home to a bus stop.	1.9	6.5	6.9	71.9	12.7	260
The distance to a bus stop affected the choice of where I live.	19.5	35.2	23.4	17.2	4.6	261

TALBE 24 (cont.)

LOCATION OF BUS STOPS AND BUS SERVICE

	Percentage Distribution of Responses					
Statement	Strongly Disagree	Dis-Agree	No Opinion	Agree	Strongly Agree	N
I would not mind if the bus route was along the street in front of my home.	37.0	22.5	13.7	22.9	3.8	262
I would not object to a bus stop in front of my home.	44.9	24.3	10.6	16.3	3.8	263
The bus should follow a more direct route through Baturyn.	6.9	32.2	38.7	16.5	5.7	261
Motor vehicles travel too quickly along the street in front of my home.	5.4	38.7	16.1	19.1	20.7	261

Table 25

PROVISION OF PUBLIC TRANSIT FACILITIES

A. Do the following physical features exist in Baturyn?

Feature	Percentage Distribution of Responses Yes	No	Don't Know	N
Bus shelters	55.1	38.0	6.8	263
Benches at bus stops	58.3	34.1	7.6	264
Sidewalks alongside roads	90.2	8.3	1.5	265
Walkways	79.6	12.7	7.7	260
Street lighting	96.2	3.4	0.4	266

B. How would the following features affect the quality of the Baturyn neighbourhood?

Feature	Percentage Distribution of Responses Take Away	Add	No Difference	N
Bus shelters	7.5	82.4	10.2	255
Benches at bus stops	5.1	78.7	16.2	253
Sidewalks alongside roads	1.6	80.5	18.0	256
Walkways	3.1	77.6	19.3	254
Street lighting	0.8	86.9	12.4	259

	Percentage Distribution of Responses Not Well Enough	Well Enough	More Than Enough	N
How well do street safety features such as lights, crosswalks, etc., meet the needs of Castle Downs?	67.7	31	0.8	260

TABLE 26

BUS STOP USUALLY USED AND THE ROUTE USUALLY TAKEN TO THE STOP

A. BUS STOP USUALLY USED

	N	Percentage Distribution
Nearest stop	141	88.6
Farther stop with shelter	5	3.2
Farther stop with better service	11	7.0
Other farther stop	1	0.6

B. ROUTE USUALLY TAKEN TO BUS STOP

	N	Percentage Distribution
Used sidewalks	124	78.5
Used back lanes and sidewalks	5	3.2
Used walkways	27	17.1
Avoided walkways	2	1.3

trip. Walkways were used to the greatest extent by respondents in Stratum B. The design of the pedestrian system in Baturyn reflects the policy of the City of Edmonton that sidewalks are to be the major component of pedestrian accessibility with walkways playing a minor role.

Sidewalks, walkways and street lights received high levels of approval. Although street safety facilities such as crosswalks and lights were judged to be inadequate by 67.7% of respondents, and 44.1% agreed that cars travelled too quickly in the neighbourhood, 84.6% felt that a safe route to a bus stop was available. The concern for pedestrian safety and the approval of facilities which promoted that safety is in accord with the general residential planning principle of the necessity for a safe walking environment.

CONCLUSION

In the planning and construction of Castle Downs and other suburban districts, it was the policy of the City of Edmonton to accommodate future public transit operations. The analyses of the existing transit service and the household questionnaire were an attempt to evaluate the success of this policy in the Baturyn neighbourhood. The design of the neighbourhood allowed efficient public transportation operation. The alignment of the collector road brought service within 1300 feet walking distance of 97% of the dwellings and the only potential delays were at the two intersections of the collector road and Castle Downs Road. Traffic lights have since been installed at these intersections, eliminating lengthy delays. Well-lit sidewalks and walkways provided safe pedestrian routes to transit service for the survey population.

Consistent with public transit research, the results of the questionnaire showed that the preconditioning and predisposing factors of age, sex, car ownership and housing type were important determinants in modal choice. Coupling constraints, perceived availability and quality also affected the use of the transit system. Although residents thought transit service to be adequate they complained that trips by transit required too much time, that service was too infrequent and that service was not always available to their destinations. When trips were short and transfers were not required, that is to say when coupling constraints were minimized, transit use increased. By contrast, capability constraints arising from the walking distance to bus service were not an important factor in modal choice except, perhaps, for shopping trips.

The coupling constraints facing public transit users resulted in transit patrons having smaller space-time prisms than automobile drivers and passengers. At the time of the survey, transit service to the Castle Downs town centre was not available and this was reflected in the very low use of public transit for shopping trips at this centre. Adequate service to the industrial areas of the city was also lacking and, as a result, only very few respondents employed in these areas used public transit for their work trips.

In general, respondents did not object to the inclusion of public transit facilities and design features in their neighbourhood.

Walkways, although seldom used for transit access, sidewalks, shelters, benches, and street lights met with approval. Respondents either had no objection to or approved of rear lanes, although it cannot be conclusively stated whether respondents perceived that access by lanes was safer than by front drives. It appears that respondents may find buses intrusive. Although they approved of locating bus stops adjacent to any type of housing, they did not want a bus stop or bus route in front of their own homes. Perhaps most important of all, from the standpoint of residential design theory, residents did not object to the single collector road running through Baturyn. This feature, which represents the greatest departure from Perry's neighbourhood unit concept, reduced the amount of traffic in the remainder of the neighbourhood and provided a recognizable route for transit service.

Because multiple family dwellings generate more transit patronage, it is to Edmonton Transit's advantage that this type of housing be included in suburban areas. The questionnaire did not directly ask if respondents would prefer multiple family dwellings to be excluded from their neighbourhood, but most respondents objected to the mixing of apartments, town housing and row housing with detached and semi-detached housing. They also preferred that open land separate the different housing types. The results suggest that there is a limit to the amount of multiple family housing that should be included in a suburban neighbourhood, and that the policy of concentrating such housing along collector roads should be continued.

CHAPTER 7

CONCLUSION

The purposes of this thesis were, first, to determine how the physical layout of residential areas affects the opportunities for the inhabitants to use public transportation when travelling to their daily activities and, second, the acceptability to residents of those neighbourhood design features intended to facilitate public transportation. These objectives were addressed through an analysis of the public transportation planning policies of the City of Edmonton as applied to the suburban neighbourhood area of Baturyn.

A discussion of the concept of activity systems suggested possible factors influencing the use of public transit. Taking Chapin's sociological view of activity systems, individual preconditioning and predisposing factors - that is to say, the person's sex, stage in the life cycle, health, status, income, and security and investment needs - combined with the perceived quality and availability of services, determine a person's propensity to use public transportation. Alternatively, the constraints approach to activity systems as proposed by Hagerstrand suggests the use of public transportation is governed by capability constraints, which result from a combination of biological limitations and the technological limits of tools and machines, and coupling constraints, which arise from the nature of transit services offered and from the time available to the individual for the associated activities. For purposes of the research design it was proposed that residential design would have more influence on the constraints facing public transit users than on sociological factors affecting the users.

A brief summary of suburban residential planning theory and practice revealed that public transportation has largely been ignored in the past. Planners have tended to focus on automobile or pedestrian access, although public transportation has received greater attention in British new town planning. Similarly, the City of Edmonton during the late 1960s and the 1970s began to promote public transportation as an attractive alternative to the automobile. Special steps were then taken to accommodate public transportation during the planning of residential areas. The case of Castle Downs, a large suburban tract within the city limits, was therefore examined and it was shown that these policies did in fact affect residential design. A detailed analysis of the Baturyn neighbourhood in Castle Downs showed that public transit continued to be accommodated at the more detailed design and the construction stages. Finally, a household survey in Baturyn was administered in an attempt to determine if the physical design of the neighbourhood influenced transit use and if the residents perceived the transit-related features to affect the quality of their neighbourhood.

ASSESSMENT OF THE THESIS PROCEDURES AND RESULTS

Constraints Affecting Public Transit Users in Baturyn

Because intra-urban travel is not usually undertaken for its own sake but is necessary so that individuals can partake in various activities, it is a major constraint on the ability to participate. People must have access to private or public transportation that can ferry them to the desired destinations within the available windows of time. If policy makers and planners wish to increase the use of public transit or improve accessibility to facilities for transit users, they must attempt to reduce constraints and, in so doing, improve the perceived availability and quality of transit services.

Capability and coupling constraints are the most important restrictions facing transit users. Walking distance to transit service is the major capability constraint and it is accepted that patronage declines as walking distances increase. To reduce the severity of this constraint, CMHC (1979) has recommended that residential areas should be designed so that bus service can be brought to within 660 feet of at least 40% of all dwellings and within 1300 feet of 85% of all dwellings. As well, the walking environment needs to be safe, pleasant and well lit so as to minimize perceived walking distances.

The results of the questionnaire survey of Baturyn suggest that the efforts made during the planning stages to minimize capability constraints facing transit users were successful. Respondents of the survey found that sidewalks and walkways permitted a short and safe walk to bus stops. All but 3.3% of the households were within Edmonton Transit's standard of 1300 feet maximum walking distance of a bus stop. All town and row housing, as well as two-thirds of all the households, were within Edmonton Transit's guideline of 650 feet walking distance for multiple family housing. Non-transit users did not perceive walking distances to affect their choice of travel mode, except when small children accompanied them or when there were parcels to carry. Therefore, it is concluded that capability constraints were not important factors affecting transit use by the survey population.

Coupling constraints are more dependent upon transit schedules and network characteristics than upon subdivision design. These constraints arise mostly from time limitations, but service must run to the desired destination if transit is to be used. In the latter case, the larger the transit network, the more likely the desired destinations will be served. The optimal transit operation for individuals with restricted windows of time is one that provides reliable, frequent services that reduces waiting time (excess travel time) combined with long hours of service to allow the individual travel schedules to be co-ordinated with activity schedules.

Amongst the survey population, coupling constraints did indeed influence transit patronage. When coupling constraints were reduced, that is to say when trips were short with direct and frequent service, transit use was greatest. Respondents overwhelmingly agreed that the main reason for not using public transportation was the availability of an automobile. By using a car, respondents escaped many of the coupling constraints facing public transit users.

Coupling constraints can be reduced by land use planning. The grouping of commercial, medical, cultural, educational and recreational facilities in town or regional centres permits multi-purpose trips, thus minimizing the constraints of the transit user's restricted space-time prism. This principle was followed in the design of the Castle Downs town centre and adjacent district campus. At the time of the survey, commercial and medical establishments existed in the town centre, and a transit centre had been constructed there as well, but the district campus, which will provide educational and recreational facilities, had not been built. Although the survey did not attempt to validate the principle of grouping diverse activities to encourage multi-purpose trips, there was some evidence that transit users in the CBD combined shopping trips with their employment trips.

The thesis has focused on the effect that residential design at the neighbourhood scale has on transit use, although some attention was also given to the larger 'district' scale. While the capability constraint of walking distance is most relevant at the neighbourhood level, the nature of the coupling constraints suggests the need for a larger scale of study which would include most, if not all, of the city. All people partake in activities throughout the city, and the bus schedules and timetables, which must be co-ordinated, are affected by the entire bus network.

It was hypothesized that residential design would affect the constraints governing transit use to a larger extent than it would affect the predisposing and preconditioning characteristics of transit users. However, the survey results indicated that preconditioning and predisposing characteristics were more important than capability constraints, and at least as important as coupling constraints, in explaining the use of public transit by respondents. Transit patrons tended to be female, the young, residents of multiple family dwellings and from households of one or no cars. These characteristics suggest that transit users were also public transit dependents. Had the question been asked "Was a car available for the bus trips taken?" rather than asking if the person had a valid driving licence, it would have been possible to determine the number of choice riders. It would then have been easier to determine the relative importance of the constraints facing the two groups.

The survey sought to determine the residents' perceptions of the availability and quality of transit service, but it failed to establish whether or not the respondents of the first 15 questions used public transit. Although three-quarters of these people found transit service to be adequate, it cannot be determined if they were transit users. Also, in Question 16, it would have been useful for transit patrons as well as non-transit users to rank the disadvantages associated with public transportation. However, it can be concluded that most respondents recognized that bus service was within an acceptable and safe walking distance of their home, and that non-transit users considered time expenditures to act as a deterrent to transit use.

Constraints Affecting the Provision of Public Transportation

From the viewpoint of the public transportation industry, residential design also affects capability and coupling constraints governing the provision of transit service. Capability constraints arise from the requirement of a suitable right-of-way on which to operate. For bus operations the road must have an adequate road bed with efficient width or increased building setbacks to permit the necessary sight lines. In Castle Downs, collector roads were designated as bus routes. By restricting access to these roads, and by employing straight-faced curbs and 'T' intersections, the potential delays that Edmonton Transit could face were minimized.

Coupling constraints arise from the need to match service with demand. During the planning stages of Castle Downs, coupling constraints that Edmonton Transit would eventually face were minimized by concentrating demand for service: the district campus was relocated to a site adjacent to the town centre, multiple family housing was placed along collector roads, and the road system was improved to allow inter-neighbourhood links. Subdivision design in Baturyn allowed good pedestrian access to bus stops, so that the bus route need not deviate from the collector road in order to meet coverage standards, and development was permitted along both sides of the collector road. The placement and number of bus stops balanced the need to maximize pedestrian access and minimize in-vehicle time.

The transit industry also operates within domain constraints in the form of operating standards set by owners or city governments. The service standards set out in the Transportation Plan Part I defined some of the domain constraints facing Edmonton Transit. In fact, the thesis did not address this issue, but it is suggested that where capability and coupling constraints are minimized it should be easier for transit service to operate within domain constraints.

With the eventual inclusion of the transportation chapter in the 1971 General Plan, the City of Edmonton embraced the policy that public transit should provide convenient access to work and leisure facilites and, in so doing, attract and cater to the heavy peak travel demand. Future public transit demand was to be accommodated in land use development. It is during the district outline plan stage that land uses and the arterial and collector road systems are broadly defined. The planning of both Castle Downs and Mill Woods began during the period when the General Plan was still under review and METS remained the official transportation plan. The original Castle Downs outline plan (North Edmonton Outline Plan, 1970), submitted to the city by a private consulting firm, followed the automobile oriented METS while Mill Woods, a city project, strongly emphasized public transportation, reflecting the evolving city policies. However, the final approved Castle Downs outline plan embodied changes aimed at improving future transit operations. With the Castle Downs outline plan as a guide, the Baturyn neighbourhood plan determined the local street system, detailed land use, bus stops and pedestrian access.

At the detailed subdivision stage, Edmonton Transit insured that the neighbourhood plan was followed and requested road sizing, straight-faced curbs and bus stops to fit its requirements. Accommodation of public transit needs influenced all three levels of plans but it appeared that major changes could not occur at the detailed subdivision stage.

Acceptability of Public Transit-Related Features

The questionnaire survey attempted to determine the residents' opinions of the transit-related design features. Had the survey been better designed, this objective could have been more fully met. A number of the questions could have been rephrased and shortened to focus more directly on public transit service.

Question 1, which was concerned with the location of different housing types and bus service, failed to ask respondents directly if they approved of the inclusion of multiple family housing in suburban residential areas and if they would object to additional multiple family housing in Baturyn. Question 2, dealing with the provision of services and facilities in Castle Downs, could have been shortened by deleting references to open space, day-care facilities and police and fire protection, none of which were directly related to transit service.

Question 3, once again, should have been restricted to transit-related physical design features. It should also have been divided into two separate questions. The first part, concerned with the recognition of the features, had no connection with the second part, the effect of the features on neighbourhood quality. Respondents should have been asked directly, rather than hypothetically, if the presence of the features affected the quality of the Baturyn neighbourhood.

Questions 14 and 15, pertaining to concerns about backing out of driveways and garbage pick-up at the front of the home, should also have been directed to respondents with rear drives and rear garbage pick up. It would then have been possible to determine if rear lanes resulted in fewer access problems and more convenient garbage disposal. Finally, and perhaps most important, respondents to the first 15 questions should have been asked if they were public transit patrons. Failure to do this made it impossssible to determine if the acceptance of transit-related features by transit patrons differed from that on non-transit users.

In spite of the above shortcomings of the questionnaire, it is concluded that respondents were satisfied that transit-related features did not compromise the quality of the residential environment. Respondents generally approved of having a main road run through the neighbourhood. There was no strong dislike for concentrating multiple family housing along the collector roads, although respondents appeared to want this housing to be segregated from detached and semi-detached housing. There was no conclusive evidence that rear lanes flanking bus routes improved driving and pedestrian safety, yet respondents appeared to approve of their existence. Straight-faced curbs met with limited opposition but it is probable that respondents were unaware of the merits of these curbs for bus and snow removal operations. Bus service was judged to improve neighbourhood quality but respondents raised mild objections to bus routes and stops in front of their own homes. This suggests that the practices of identifying bus stop location, indicating the streets on which buses may run, and requiring deeper setbacks for homes along bus routes should be continued.

Applicability of the Activity Concept to Public Transportation Research

This thesis has attempted to focus on public transportation at a neighbourhood scale. However, the nature of residents' activity patterns suggests that a larger scale is required if accessibility constraints are to be fully investigated. Most people live in domains that stretch beyond the neighbourhood to include a large part of the city. As well, the quality of public transportation services offered within a neighbourhood depends to a great extent upon the entire public transportation network. The question arises, then, was it reasonable to frame the research in the context of activity systems? My answer is yes. The concept defines the role of transportation in daily life. Most urban travel is not an activity undertaken for its own sake, but it is a major constraint defining what activities can be undertaken.

Because Hagerstrand dealt explicitly with constraints, it was hypothesized that his perception of activity systems would be most applicable to this thesis. Hagerstrand categorized constraints as capability, coupling and society-imposed, and so provided a framework for distinguishing how and to what degree the attributes of a public transportation system will affect its users. While Hagerstrand (1975) emphasized the importance of time as both a capability and a coupling constraint, transportation planners proposed that a reduction in travel time, in particular excess travel time, was the most promising way of increasing the use of public transportation. On the one hand, excess travel time can be reduced by decreasing the coupling constraints of waiting times through improving frequency of service, providing timed transfers and maintaining reliable schedules. On the other hand, excess travel time can be reduced by decreasing the capability constraint of walking distance by providing a dense network of routes, providing direct access to bus stops, and locating bus stops adjacent to high density housing and commercial, institutional, recreational and employment facilities. Residential subdivision design affects walking distances and, as was shown in the case of Baturyn, a well designed neighbourhood virtually removes walking distance as a capability constraint to public transportation use. Coupling constraints then become more important but, to address these constraints adequately, research must be done at a scale larger than the neighbourhood.

Transportation research and the survey results cited in this thesis indicate that public transportation use is largely explained by personal characteristics of the urban population. Therefore, Chapin's sociological perspective of activity systems is relevant to transportation research but his model must be adapted, as it was in Figure 5, to include transportation as a consideration in the formation of activity systems. Chapin's perspective is useful in determining at whom public transportation policies should be aimed, but Hagerstrand's constraints approach is deemed to be better for predicting how such policies can affect the scope and nature of activity systems.

IMPLICATIONS FOR CITY PLANNING

From the survey results and from the appraisal of city policies as set forth in the Transportation Plan Part I and as eventually included in the General Plan of 1971, it appears that the City of Edmonton has done a commendable job in planning residential neighbourhoods that are conducive to efficient, attractive transit service. Indeed, the CMHC guidelines for subdivision design incorporated many of Edmonton's planning practices. Therefore, it is recommended that the accommodation of public transit during planning stages be continued. This will allow Edmonton Transit at later dates either to increase or decrease service levels with the least cost and inconvenience.

The thesis has illustrated that reliance on public transit leads to reduced space-time prisms. When residential subdivision design has minimized capability constraints, coupling constraints become more important in determining the size of these prisms and the demand for transit services. Using the concept of coupling constraints, city transit planners could estimate the effects of the modifications of schedules, travel times and route configurations on individual space-time prisms and compare these effects with the costs or savings of such modifications. Such a comparison could suggest optimal strategies for network improvements or cutbacks.

SUGGESTIONS FOR FURTHER RESEARCH

The thesis focused on the use and provision of transit services in Castle Downs, an area that was designed under the policies of the Edmonton General Plan and the Transportation Plan Part I. It would be useful to make comparisons with an area developed prior to this time, or an area in a different city which lacked Edmonton's commitment to public transportation, to determine the extent of the effects of the policies and the role capability constraints have on transit use and operation. It might then be possible to determine if preconditioning and predetermining factors such as age, sex and income have a greater influence on transit patronage than do capability and coupling constraints.

The questionnaire results showed that the availability of private automobiles was the most important reason for shunning public transit, and that as household car ownership increased, transit patronage decreased. Residential neighbourhoods in North America are designed to provide optimal automobile access both to the private dwelling and to community facilities. Research could therefore be directed to the concept of designing areas that restrain automobile use. Access to the automobile could be reduced through community garages or parking lots at some distance from private dwellings. Not only would walking distances to private and public transit be more equal but substantial savings could be realized from the reduced local road network. Public transit rights-of-way could be made more direct and perhaps exclusive, so that in-vehicle travel times would approach those of automobiles.

It is realized, of course, that to be able to implement such policies it would first be necessary to achieve a radical re-orientation of the emphasis now placed on private transportation in North America.

Finally, research should continue to seek methods for developing transportation models which embody the concept of activity systems. The concept encourages the integration of land use and transportation policies by emphasizing that intra-urban travel is rarely undertaken for its own sake but is, instead, a severe constraint on the ability to use urban facilities and partake in urban activities. The concept also allows insight into the effect of these policies on the individual and, in so doing, may suggest which constraints are most influential on behaviour. This, in turn, might indicate the direction that transportation and land use planning should take.

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J.S. Krooner to F. Peters, Reid, Crowther & Partners Ltd., February 19, 1971.

J.S. Krooner to R. Spencer, Planning Department, March 3, 1971.

D.L. MacDonald, General Manager, to S.C. Rodgers, General Manager, Planning Department, May 27, 1971.

Correspondence (cont.)

City of Edmonton Engineering Department:

D. Gafuik to R. Spencer, Planning Department, March 3, 1971.

R.E. Plunkett, Transportation Planning Branch to R.A. Spencer, Planning Department, January 25, 1973.

R.E. Plunkett, Transportation Planning Branch to G.D. Price, B.A.C.M. Development Corporation Ltd., February 12, 1973.

G. Hodge, City Engineer, to R. Speelman, Planning Department, February 16, 1973.

G. Hodge, City Engineer, to S.C. Rodgers, General Manager of Planning Department:
January 9, 1974
May 15, 1974
January 8, 1975
January 30, 1976
April 14, 1976
November 17, 1976
March 10, 1977
April 22, 1977
October 31, 1977

City of Edmonton Planning Department:

S.C. Rodgers, General Manager to N.F. Bothwell, B.A.C.M. Development Corporation Ltd., March 8, 1973.

Price, G.D., B.A.C.M. Development Corporation Ltd., to Secretary of Municipal Planning Commission, City of Edmonton, June 10, 1975.

APPENDIX

THE HOUSEHOLD SURVEY

DEPARTMENT OF GEOGRAPHY
TELEPHONE (403) 432-3274

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA T6G 2H4

October 30, 1981

Dear Baturyn Resident,

I am a graduate student at the University of Alberta and I am studying public transportation in new residential areas. As part of my studies I am conducting this survey to determine how well the planners who designed your neighbourhood anticipated your public transportation needs. The goal of my studies is to suggest ways to improve transportation planning in future Edmonton neighbourhoods.

The results of this survey will be made available to Edmonton Transit, however, I assure you that you will remain anonymous. The statistical results only will appear in my Masters thesis.

It is important that you complete this questionnaire. The distribution of the questionnaire is limited and your answers will represent the opinions of all residents in Baturyn. The questionnaire is not difficult to complete. It should take between 20 and 30 minutes to answer all the questions.

Thank-you for your co-operation. Your time and interest will greatly help me to complete my studies.

Sincerely,

Jean Frost

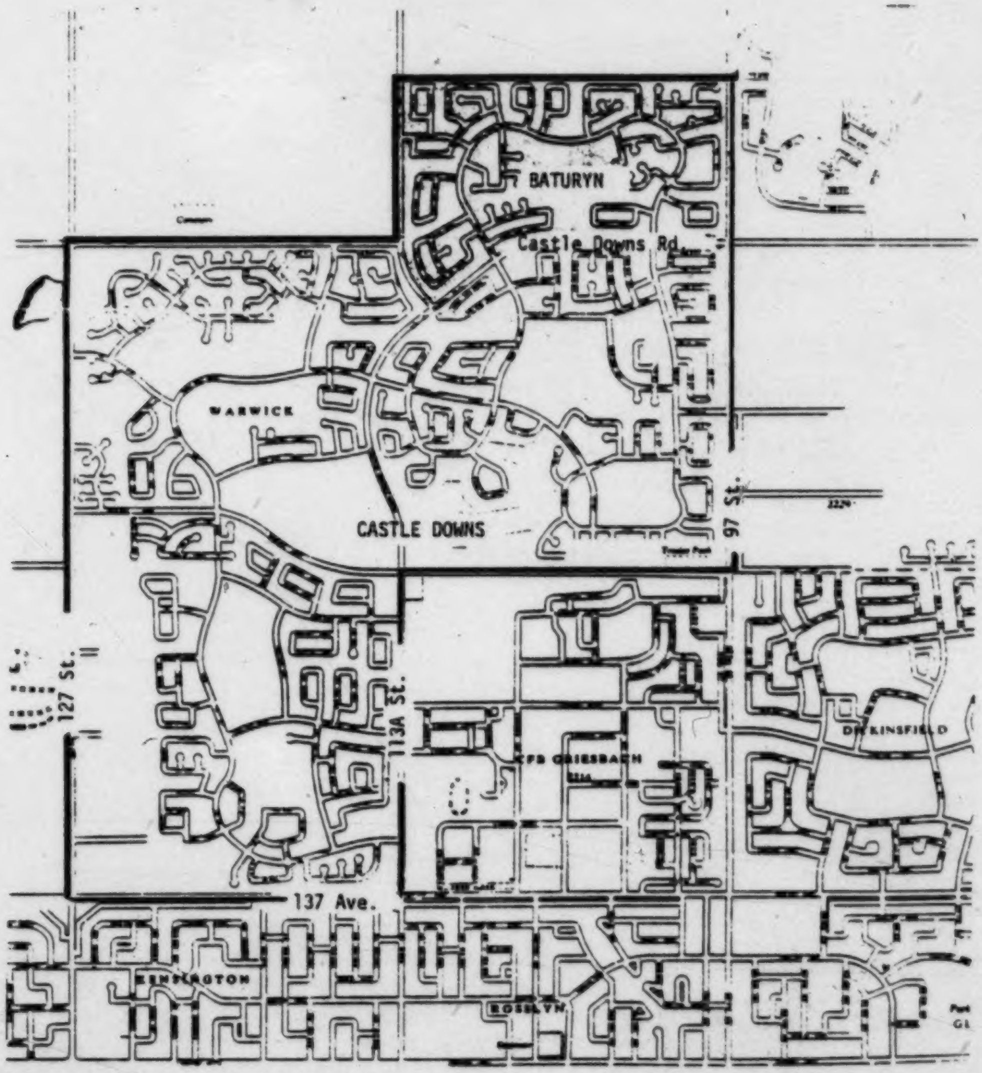
Jean Frost
Graduate Student.

BATURYN TRANSPORTATION SURVEY

GENERAL INSTRUCTIONS

USE EITHER A PEN OR PENCIL TO COMPLETE THIS SURVEY. SOME QUESTIONS REQUIRE WRITTEN ANSWERS, OTHER QUESTIONS MAY BE ANSWERED SIMPLY BY CHECKING ✓ THE APPROPRIATE ANSWER. PLEASE BIVE ONLY ONE ANSWER FOR EACH OF THE MULTIPLE CHOICE QUESTIONS. PLEASE GIVE YOUR PERSONAL OPINIONS FOR EACH OF THE QUESTIONS ASKED.

THE MAP BELOW SHOWS THE BATURYN NEIGHBOURHOOD AND ITS LOCATION IN CASTLE DOWNS. BATURYN IS THE NEIGHBOURHOOD IN WHICH YOU LIVE.


BATURYN
Castle Downs Rd.
WARWICK
CASTLE DOWNS
97 St.
127 St.
113A St.
CFB GRIESBACH
DICKINSFIELD
137 Ave.
KENSINGTON
ROSSLYN

Office Use Only

1. First, I would like your opinion about the location of different types of housing and of bus service within new residential areas such as Castle Downs. Please check ✓ whether you strongly disagree, disagree, have no opinion, agree, or strongly agree with the following statements.

	STRONGLY DISAGREE	DISAGREE	NO OPINION	AGREE	STRONGLY AGREE	1.
Schools and parks should be located next to apartments.						a ☐
Bus stops should be located next to apartments						b ☐
Schools and parks should be located next to row housing and town housing.						c ☐
Bus stops should be located next to row housing and town housing.						d ☐
Schools and parks should be located next to duplexes and detached houses.						e ☐
Bus stops should be located next to duplexes and detached houses						f ☐
Bus stops should be located next to schools. .						g ☐
Bus stops should be located next to neighbourhood stores.						h ☐
Apartments should be scattered among duplexes and detached houses						i ☐
Row housing and town housing should be scattered among duplexes and detached houses.						j ☐

2. On Page 1 of this survey is a map of Castle Downs. At present, how well do the following facilities meet the present needs of Castle Downs? How well is Castle Downs provided with the following services? Please check ✓ only one answer for each service or facility.

TYPE OF SERVICE OR FACILITY	MEETING OF PRESENT NEEDS			2.
	NOT WELL ENOUGH	WELL ENOUGH	MORE THAN WE NEED	
Open space for family use (parks, green areas) .				a ☐
Roads and streets.				b ☐
Bus service.				c ☐
Commercial facilities (shops, stores, etc.). . .				d ☐
Elementary schools				e ☐
Junior high schools.				f ☐
Senior high schools.				g ☐
Daycare facilities				h ☐
Community recreation facilities.				i ☐
Police and fire protection				j ☐
Street safety features such as lights, crosswalks, etc.				k ☐

Office Use Only

ON PAGE 4 OF THIS SURVEY IS A MAP OF BATURYN, THE NEIGHBOURHOOD IN WHICH YOU LIVE

3. The physical design features listed below are often included in the planning and designing of residential areas. Along with the different types of housing and the availability of services and facilities, various physical design features greatly affect the quality of a residential area. | 3.

Please answer both parts of this question.

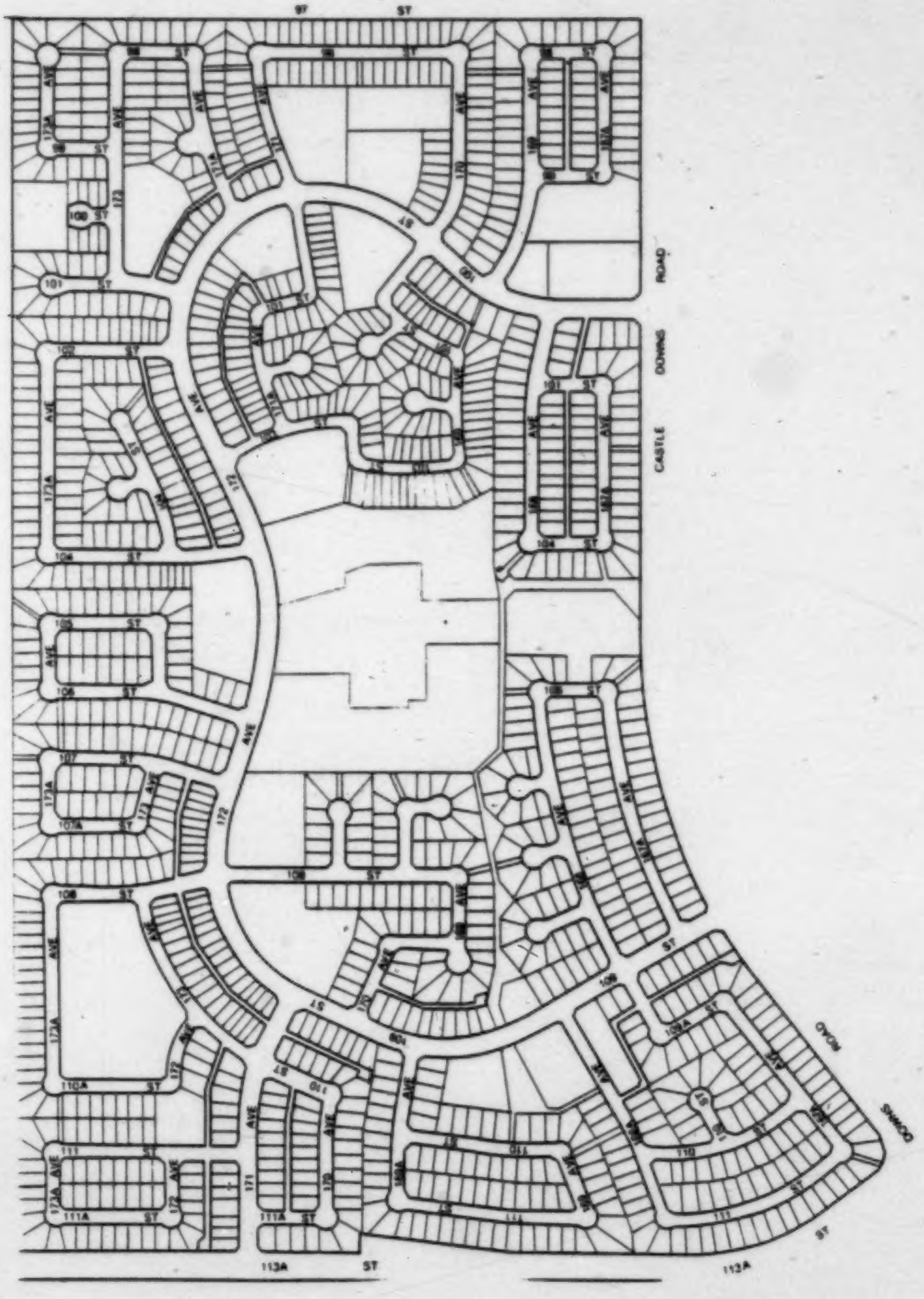
Part 1 - Beside each physical design feature please indicate whether the feature exists in Baturyn.

Part 2 - In your opinion, would each of the physical design features add to the quality of Baturyn, take away from the quality, or make no difference?

	PART 1 EXISTS			PART 2 AREA QUALITY					
PHYSICAL DESIGN FEATURE	YES	NO	DON'T KNOW	TAKE AWAY	ADD	NO DIFFER.			
Alleys and lanes							a		
Parks and tot lots							b		
Sidewalks alongside roads							c		
Walkways							d		
Straight faced street curbs							e		
Rolled street curbs							f		
Land barriers or berms							g		
Street lighting							h		
Underground power and telephone lines							i		
Open space to separate different types of housing							j		
Key-hole crescents (dead end streets with turn arounds) . .							k		
Neighbourhood commercial centre . .							l		
Bus shelters							m		
Benches at bus stops							n		
School and park area located in centre of neighbourhood . .							o		
One main road which runs through neighbourhood							p		
Apartments concentrated along main road							q		
Row housing and town housing concentrated along main road .							r		

MAP OF BATURYN

USE THIS MAP FOR QUESTIONS 3, 4, AND 5.


97 ST
AVE
173A
ST
100 ST
173
101 ST
171A
172
170
ST
ST
AVE
181A
ROAD
DOWNS
CASTLE
101 ST
102 ST
AVE
171A
ST
AVE
172
173A
104 ST
104 ST
105 ST
AVE
106 ST
AVE
107 ST
173A
AVE
171
107A ST
172
108 ST
108 ST
AVE
AVE
AVE
181A
AVE
173A
110A ST
172
AVE
171
109 ST
AVE
170
110 ST
AVE
110
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109A ST
AVE
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110 ST
ROAD
DOWNS
111 ST
AVE
173A
111A ST
172
AVE
111A ST
111 ST
111 ST
113A ST
112A ST

4. Now I would like your opinion on some aspects of bus service in Baturyn. Please check ✓ whether you strongly disagree, disagree, have no opinion, agree or strongly agree with the following statements.

	STRONGLY DISAGREE	DISAGREE	NO OPINION	AGREE	STRONGLY AGREE
It is easy to find the bus stops in Baturyn					
There are enough bus shelters in Baturyn . .					
There are enough benches at bus stops in Baturyn					
I would like a bus stop closer to my home :					
Sidewalks and walkways provide a safe route from my home to the bus stop.					
The distance to a bus stop affected the choice of where I live					
I would not mind if the bus route was along the street in front of my home					
I would not object to a bus stop in front of my home					
The bus should follow a more direct route through Baturyn					
Motor vehicles travel too quickly along the street in front of my home					

Office Use Only

4.

a ☐
b ☐
c ☐
d ☐
e ☐
f ☐
g ☐
h ☐
i ☐
j ☐

5. If you or any of your family use the bus, please draw on the map on Page 4 how you or the family member usually walk from your home to the bus stop where you catch the bus.

I WOULD LIKE TO ASK YOU SOME GENERAL QUESTIONS ABOUT YOUR HOUSEHOLD AND YOUR HOME.	Office Use Only
6. Are you male or female? Male ☐ Female ☐	6 ☐
7. How many persons live at this address? ____________	7 ☐
8. How many cars are available for use by the household? ________	8
9. Please check ✓ if you rent or own you home. Rent ☐ Own ☐	9 ☐
10. Please check ✓ what type of yome you live in. Apartment ☐ Row house or town house ☐ Duplex ☐ Single family or detached house ☐	10 ☐
IF YOU LIVE IN AN APARTMENT, A TOWN HOUSE OR A ROW HOUSE, PLEASE GO ON TO QUESTION 16. IF YOU LIVE IN A DUPLEX OR A DETACHED HOUSE PLEASE CONTINUE WITH QUESTION 11.	
11. Is there a rear lane or alley behind or beside your home? Yes ☐ No ☐	11 ☐
12. Was the decision to buy or rent your home affected by the existence or absence of a rear lane or alley? Yes ☐ No ☐	12 ☐
13. Do you have a front drive? Yes ☐ No ☐	13 ☐
14. If you have a front drive, do you have any concerns about backing out of the drive way? Yes ☐ No ☐	14a ☐
If yes, what are the concerns? ____	b ☐
15. Is your garbage picked up at the front of your home? Yes ☐ No ☐	15a ☐
If yes, does this present any problems and what are the problems? ____	b ☐

16. Finally for each person of school age or older living at this address please answer the following questions:

PERSON 1

a. How old is Person 1? ____________

b. What is the sex of Person 1? Male ☐ Female ☐

c. What is the occupation of Person 1? ________________

d. What is the address (street and avenue only) where Person 1 works or what is the name of the school Person 1 attends?

____

e. Does Person 1 hold a valid driving licence? Yes ☐ No ☐

f. How does Person 1 usually travel to the place of employment or to school?
- Drive. ☐
- Passenger in a car . . . . ☐
- School bus . . . . ☐
- Regular bus. . . . . ☐
- Walk . . . . ☐
- Other (please specify)________________ . ☐

g. How often does Person 1 shop at the following shopping centres (for example, 1 time a week, 2 times a month)? How does Person 1 usually travel to these centres?

	HOW OFTEN	METHOD OF TRAVEL
Neighbourhood Store		
Castle Downs Town Centre. . .		
Northwood or North Town Mall.		
Londonderry Mall.		
Downtown.		
Other ________________ .		

h. How does Person 1 usually travel when making the following trips?

Visits to the doctor, dentist, lawyer, etc. ________________

Visits to friends ________________________________

Trips for recreation purposes, for example, trips to the library swimming pool, movies, parks, etc. ________________

i. If Person 1 seldom or never uses the bus, please tell me why. Choose the three most important reasons why Person 1 does not use the bus for school or employment trips, for shopping trips, and for other trips. Rank these three reasons in order of importance: 1 - most important; 2 - less important; 3 - least important. Choose three reasons only.

	TYPE OF TRIP		
	EMPLOYMENT OR SCHOOL	SHOPPING	VISITS TO THE DOCTOR, FRIENDS LIBRARY, ETC.
The destination is within walking or cycling distance			
A car is available for the trip . . .			
The nearest bus stop is too far from home			
Bus service is too infrequent			
The bus takes too long			
The bus does not travel to the destination			
Other (please specify) __________ ____________________ .			

Office Use Only

a ☐
b ☐
c ☐
d ☐
e ☐
f ☐
g
1 ☐☐
2 ☐☐
3 ☐☐
4 ☐☐
5 ☐☐
6 ☐☐
h
1 ☐
2 ☐
3 ☐
i
1 ☐☐☐
2 ☐☐☐
3 ☐☐☐
4 ☐☐☐
5 ☐☐☐
6 ☐☐☐
7 ☐☐☐

Office Use Only

16. PERSON 2

a. How old is Person 2? ______________ a ☐

b. What is the sex of Person 2? Male ☐ Female ☐ b ☐

c. What is the occupation of Person 2? ______________ c ☐

d. What is the address (street and avenue only) where Person 2 works or what is the name of the school that Person 2 attends? d ☐

____

e. Does Person 2 hold a valid driving licence? Yes ☐ No ☐ e ☐

f. How does Person 2 usually travel to the place of employment or to school? f ☐

Drive. . . . . ☐
Passenger in a car . . . . ☐
School bus . . . . ☐
Regular bus. . . . . ☐
Walk . . . . ☐
Other (please specify) ______________ . ☐

g. How often does Person 2 shop at the following shopping centres (for example, 1 time a week, 2 times a month)? How does Person 2 usually travel to these centres? g

	HOW OFTEN	METHOD OF TRAVEL
Neighbourhood Store		
Castle Downs Town Centre. . .		
Northwood or North Town Mall.		
Londonderry Mall.		
Downtown.		
Other ______________ .		

1 ☐☐
2 ☐☐
3 ☐☐
4 ☐☐
5 ☐☐
6 ☐☐

h. How does Person 2 usually travel when making the following trips? h

Visits to the doctor, dentist, lawyer, etc. ______________ 1 ☐
Visits to friends ______________ 2 ☐
Trips for recreation purposes, for example, trips to the library swimming pool, movies, parks, etc. ______________ 3 ☐

i. If Person 2 seldom or never uses the bus, please tell me why. Choose the three most important reasons why Person 2 does not use the bus for school or employment trips, for shopping trips, and for other trips. Rank these three reasons in order of importance: 1 - most important; 2 - less important; 3 - least important. Choose three reasons only. i

	TYPE OF TRIP		
	EMPLOYMENT OR SCHOOL	SHOPPING	VISITS TO THE DOCTOR, FRIENDS LIBRARY, ETC.
The destination is within walking or cycling distance			
A car is available for the trip. . .			
The nearest bus stop is too far from home			
Bus service is too infrequent. . . .			
The bus takes too long			
The bus does not travel to the destination.			
Other (please specify) ______________			

1 ☐☐☐
2 ☐☐☐
3 ☐☐☐
4 ☐☐☐
5 ☐☐☐
6 ☐☐☐
7 ☐☐☐

PERSON 3

16. a. How old is Person 3? ____________

b. What is the sex of Person 3? Male ☐ Female ☐

c. What is the occupation of Person 3? ____________

d. What is the address (street and avenue only) where Person 3 works or what is the name of the school that Person 3 attends?

____

e. Does Person 3 hold a valid driving licence? Yes ☐ No ☐

f. How does Person 3 usually travel to the place of employment or to school?

- Drive. . . . . ☐
- Passenger in a car . . . . ☐
- School bus . . . . ☐
- Regular bus. . . . . ☐
- Walk . . . . ☐
- Other (please specify) ____________ . ☐

g. How often does Person 3 shop at the following shopping centres (for example, 1 time a week, 2 times a month)? How does Person 3 usually travel to these centres?

	HOW OFTEN	METHOD OF TRAVEL
Neighbourhood Store		
Castle Downs Town Centre. . .		
Northwood or North Town Mall.		
Londonderry Mall.		
Downtown.		
Other ____________ .		

h. How does Person 3 usually travel when making the following trips?

Visits to the doctor, dentist, lawyer, etc. ____________

Visits to friends ____________

Trips for recreation purposes, for example, trips to the library swimming pool, movies, parks, etc. ____________

i. If Person 3 seldom or never uses the bus, please tell me why. Choose the three most important reasons why Person 3 does not use the bus for school or employment trips, for shopping trips, and for other trips. Rank these three reasons in order of importance: 1 - most important; 2 - less important; 3 - least important. Choose three reasons only.

	TYPE OF TRIP		
	EMPLOYMENT OR SCHOOL	SHOPPING	VISITS TO THE DOCTOR, FRIENDS LIBRARY, ETC.
The destination is within walking or cycling distance			
A car is available for the trip. . .			
The nearest bus stop is too far from home			
Bus service is too infrequent. . . .			
The bus takes too long			
The bus does not travel to the destination.			
Other (please specify) ____________ ____________			

Office Use Only

a ☐
b ☐
c ☐
d ☐
e ☐
f ☐

g

1		
2		
3		
4		
5		
6		

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1 ☐
2 ☐
3 ☐

i

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2			
3			
4			
5			
6			
7			

Office Use Only

PERSON 4

16. a. How old is Person 4? ____________

b. What is the sex of Person 4? Male ☐ Female ☐

c. What is the occupation of Person 4? ____________

d. What is the address (street and avenue only) where Person 4 works or what is the name of the school that Person 4 attends?

____

e. Does Person 4 hold a valid driving licence? Yes ☐ No ☐

f. How does Person 4 usually travel to the place of employment or to school?

Drive. . . . . ☐
Passenger in a car . . . . ☐
School bus . . . . ☐
Regular bus. . . . . ☐
Walk . . . . ☐
Other (please specify) ____________ . ☐

g. How often does Person 4 shop at the following shopping centres (for example, 1 time a week, 2 times a month)? How does Person 4 usually travel to these centres?

	HOW OFTEN	METHOD OF TRAVEL
Neighbourhood Store		
Castle Downs Town Centre. . .		
Northwood or North Town Mall.		
Londonderry Mall.		
Downtown.		
Other ____________ .		

h. How does Person 4 usually travel when making the following trips?

Visits to the doctor, dentist, lawyer, etc. ____________

Visits to friends ____________

Trips for recreation purposes, for example, trips to the library swimming pool, movies, parks, etc. ____________

i. If Person 4 seldom or never uses the bus, please tell me why. Choose the three most important reasons why Person 4 does not use the bus for school or employment trips, for shopping trips, and for other trips. Rank these three reasons in order of importance:
1 - most important; 2 - less important; 3.- least important.
Choose three reasons only.

	TYPE OF TRIP		
	EMPLOYMENT OR SCHOOL	SHOPPING	VISITS TO THE DOCTOR, FRIENDS LIBRARY, ETC.
The destination is within walking or cycling distance			
A car is available for the trip. . .			
The nearest bus stop is too far from home			
Bus service is too infrequent. . . .			
The bus takes too long			
The bus does not travel to the destination.			
Other (please specify) ____________ ____________			

a ☐
b ☐
c ☐
d ☐
e ☐
f ☐
g
1 ☐☐
2 ☐☐
3 ☐☐
4 ☐☐
5 ☐☐
6 ☐☐
h
1 ☐
2 ☐
3 ☐
i
1 ☐☐☐
2 ☐☐☐
3 ☐☐☐
4 ☐☐☐
5 ☐☐☐
6 ☐☐☐
7 ☐☐☐

PERSON 5

16. a. How old is Person 5? ______________

b. What is the sex of Person 5? Male ☐ Female ☐

c. What is the occupation of Person 5? ____________________

d. What is the address (street and avenue only) where Person 5 works or what is the name of the school that Person 5 attends?

____

e. Does Person 5 hold a valid driving licence? Yes ☐ No ☐

f. How does Person 5 usually travel to the place of employment or to school?

Drive. . . . . ☐
Passenger in a car . . . . ☐
School bus . . . . ☐
Regular bus. . . . . ☐
Walk . . . . ☐
Other (please specify) ____________ . ☐

g. How often does Person 5 shop at the following shopping centres (for example, 1 time a week, 2 times a month)? How does Person 5 usually travel to these centres?

	HOW OFTEN	METHOD OF TRAVEL
Neighbourhood Store		
Castle Downs Town Centre. . .		
Northwood or North Town Mall.		
Londonderry Mall.		
Downtown.		
Other ______________ .		

h. How does Person 5 usually travel when making the following trips?

Visits to the doctor, dentist, lawyer, etc. ______________

Visits to friends ______________________

Trips for recreation purposes, for example, trips to the library swimming pool, movies, parks, etc. ______________

i. If Person 5 seldom or never uses the bus, please tell me why. Choose the three most important reasons why Person 5 does not use the bus for school or employment trips, for shopping trips, and for other trips. Rank these three reasons in order of importance:
1 - most important; 2 - less important; 3 - least important.
Choose three reasons only.

	TYPE OF TRIP		
	EMPLOYMENT OR SCHOOL	SHOPPING	VISITS TO THE DOCTOR, FRIENDS LIBRARY, ETC.
The destination is within walking or cycling distance			
A car is available for the trip. . .			
The nearest bus stop is too far from home			
Bus service is too infrequent. . . .			
The bus takes too long			
The bus does not travel to the destination.			
Other (please specify) ____________ ______________________			

Office Use Only

a ☐
b ☐
c ☐
d ☐
e ☐
f ☐
g
1 ☐☐
2 ☐☐
3 ☐☐
4 ☐☐
5 ☐☐
6 ☐☐
h
1 ☐
2 ☐
3 ☐
i
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2 ☐☐☐
3 ☐☐☐
4 ☐☐☐
5 ☐☐☐
6 ☐☐☐
7 ☐☐☐

PERSON 6

16. a. How old is Person 6? ____________

b. What is the sex of Person 6? Male ☐ Female ☐

c. What is the occupation of Person 6? ____________________

d. What is the address (street and avenue only) where Person 6 works or what is the name of the school that Person 6 attends?

____

e. Does Person 6 hold a valid driving licence? Yes ☐ No ☐

f. How does Person 6 usually travel to the place of employment or to school?

- Drive. . . . . ☐
- Passenger in a car . . . . ☐
- School bus . . . . ☐
- Regular bus. . . . . ☐
- Walk . . . . ☐
- Other (please specify) ____________ . ☐

g. How often does Person 6 shop at the following shopping centres (for example, 1 time a week, 2 times a month)? How does Person 6 usually travel to these centres?

	HOW OFTEN	METHOD OF TRAVEL
Neighbourhood Store		
Castle Downs Town Centre. . .		
Northwood or North Town Mall.		
Londonderry Mall.		
Downtown.		
Other ____________ .		

h. How does Person 6 usually travel when making the following trips?

Visits to the doctor, dentist, lawyer, etc. ______________

Visits to friends ____________________________

Trips for recreation purposes, for example, trips to the library swimming pool, movies, parks, etc. ______________

i. If Person 6 seldom or never uses the bus, please tell me why. Choose the three most important reasons why Person 6 does not use the bus for school or employment trips, for shopping trips, and for other trips. Rank these three reasons in order of importance:
1 - most important; 2 - less important; 3 - least important.
Choose three reasons only.

	TYPE OF TRIP		
	EMPLOYMENT OR SCHOOL	SHOPPING	VISITS TO THE DOCTOR, FRIENDS LIBRARY, ETC.
The destination is within walking or cycling distance			
A car is available for the trip. . .			
The nearest bus stop is too far from home			
Bus service is too infrequent. . . .			
The bus takes too long			
The bus does not travel to the destination.			
Other (please specify) ____________ ____________			

Office Use Only

a ☐
b ☐
c ☐
d ☐
e ☐
f ☐
g

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2 ☐
3 ☐

i

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4			
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6			
7			

IF YOU HAVE ANY ADDITIONAL COMMENTS ABOUT PUBLIC TRANSPORTATION PLANNING OR PUBLIC TRANSPORTATION FACILITIES IN BATURYN, PLEASE WRITE THE COMMENTS AT THE BOTTOM OF THIS PAGE.

THANK-YOU FOR COMPLETING THIS SURVEY. LET ME ASSURE YOU THAT YOU WILL REMAIN ANONYMOUS.

IT WOULD BE GREATLY APPRECIATED IF YOU WOULD CALL 439-2452 WHEN YOU HAVE COMPLETED THE SURVEY. AN ANSWERING MACHINE WILL TAKE YOUR MESSAGE BETWEEN 7:30 A.M. AND 11:00 P.M.

PLEASE LEAVE YOUR ADDRESS AND A TIME THAT YOU WILL BE HOME SO THAT I MAY PICK UP THE SURVEY. ALTERNATIVELY, LEAVE YOUR ADDRESS AND STATE THAT YOU WILL LEAVE THE SURVEY IN YOUR MAIL BOX SO THAT I MAY PICK UP THE SURVEY.

THANK-YOU AGAIN.

DEPARTMENT OF GEOGRAPHY
TELEPHONE (403) 432-3274

THE UNIVERSITY OF ALBERTA
EDMONTON, CANADA T6G 2H4

NOVEMBER, 1981

DEAR BATURYN RESIDENT,

RECENTLY I DELIVERED A TRANSPORTATION SURVEY TO YOUR HOME. I CALLED AT YOUR HOME TODAY TO PICK UP THE SURVEY BUT YOU WERE NOT IN. I WOULD GREATLY APPRECIATE IT IF YOU WOULD COMPLETE THE SURVEY AND THEN TELEPHONE ME AT 439-2452 BETWEEN 7:30 A.M. AND 11:00 P.M. IF I AM NOT AT HOME A TELEPHONE ANSWERING SERVICE WILL TAKE YOUR MESSAGE. PLEASE LEAVE YOUR ADDRESS AND A TIME WHEN I MAY PICK UP THE SURVEY. YOU MAY LEAVE THE COMPLETED SURVEY IN YOUR MAIL BOX.

THIS SURVEY IS IMPORTANT FOR MY RESEARCH AND I THANK-YOU FOR YOUR TIME AND HELP.

SINCERELY,

Jean Frost

JEAN FROST
GRADUATE STUDENT